X-RAY GENERATOR

HF 300 / HF 600
HF 3SE / HF 3SEE

OPERATOR'S MANUAL

HCMI

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DATE	PAGE	DESCRIPTION
05/22/01	B	DESCRIPTION MICROPROCESSOR BOARDS A272-A172SE
	16 SEC E	TABLE 5-1
	21 SEC E	FIG 5-11 DINRAIL LAYOUT +30VDC
	22 SEC E	FIG 5-12 DINRAIL LAYOUT +30VDC
	2 SEC F	SOURCE CHARGER CAL. A 288 ES
	3 SEC F	RE-WRITE CALIBRATION INSTRUCTIONS
	5 SEC F	ADDED CORRECT DECIMAL VOLTAGE VALUES
	6 SEC F	REMOVED kVp CALIBRATION TEXT
	7 SEC F	PARAGRAPH C. D. REMOVED
	8 SEC F	ADDED Kv WARNING FIGURE
	9 SEC F	ADDED STEP 9
	10 SEC F	REMOVED SES 410, DC REF, 380 DISPLAY WINDOWS
	11 SEC F	FILAMENT RESISTOR BOARD A6 TO A 186
	12 SEC F	AEC CALIBRATION RE-WRITTEN
	14 SEC F	AEC CALIBRATION RE-WRITTEN
	15 SEC F	AEC CALIBRATION RE-WRITTEN
	16 SEC F	ADDED PART NUMBER MICRO. PROC. BOARD A-172/272
	7 SEC G	OMIT NOTE
	8 SEC G	ADD PART NUMBER A-172/272
	9 SEC G	ADD PART NUMBER A-172/272
	10 SEC G	OMIT COMPLETE PAGE
	3 SEC H	SOURCE CHARGER VOLTAGE - SE ONLY
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	3 SEC D	ADDED ERROR MESSAGES
	SCHEMATICS	A-299 CATHODE AND ANODE REVERSED
	SCHEMATICS	A-267 C16 CONNECTION
	SCHEMATICS	HF-300/HF-600 STAND BY POWER SUPPLY
	SCHEMATICS	HF-3SE/HF3-SEE STAND BY POWER SUPPLY
09/10/01	3 SEC F	HF-3SE/HF3-SEE #5 CHANGED J1 TO J3
	3 SEC F	HF-3SE/HF3-SEE #6 CHANGED J1 TO J3
12/21/01	14 SEC B	Amp MOM: 220 RMS CHANGED TO Amp MOM: 225RMS
02/07/02	SCHEMATICS	EUREKA TRUE SPEED BUCKY ADDED
03/12/02	SCHEMATICS	SEE 10-24. IN HF3-SEE UNITS, WIRE ADDED TO WIRE HARNESS
05/02/02	3 SEC F	CHANGE THE SPECIFICATION FOR ADJUSTING THE OUTPUT VOLTAGE OF THE A-188/A-288 SOURCE CHARGER BOARD FRO +/-204-206 VDC TO +/-212 VDC.
06/18/02	SCHEMATICS	REVISED SCHEMATICS
06/04/04	Entire Manual	Separated Operators Manual and Installation Manual. Installation Manual now provided through website and on CD. Operators Manual provided on CD and Hard copy to customer.

Pre-Installation

The pre-installation document provides necessary information and data to plan and prepare the customers site prior to equipment delivery and installation.

This document considers only the generators, operators control panel and associated components.

RESPONSIBILITY OF PURCHASER:

Site preparation is the responsibility of the purchaser. The following should be considered **before delivery of system components**.

- Install required material for radiation shielding.
- Complete room floor, ceiling and wall finish.
- Install wire raceway, conduit and ground points.
- Install proper size wire junction boxes with covers at locations specified in the installation plans.
- Install power mains with proper size conductors voltage rating and kVa (see Table 2-0 pg.14).
- Install safety devices according to service manual and local codes.
- Install wall support materials if specified for tubestand, wall holders and operators control panel.
- Contact local building inspectors before installation for any additional requirements necessary to your location, etc.

Completing **ALL** pre-installation requirements will avoid delays and confusion.

PRODUCT PRE-INSTALLATION DATA

Dimensions:

Power Cabinet	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
HF300	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**148 kg 325 lb**	**2559**	**378.62 dm³ 23105 cu in**
HF600	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**148 kg 325 lb**	**2559**	**378.62 dm³ 23105 cu in**

Stored Energy	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
HF3 SE	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**183 kg 402 lb**	**2661**	**378.62 dm³ 23105 cu in**
HF3 SEE	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**183 kg 402 lb**	**2661**	**378.62 dm³ 23105 cu in**

Pre-Installation

continued

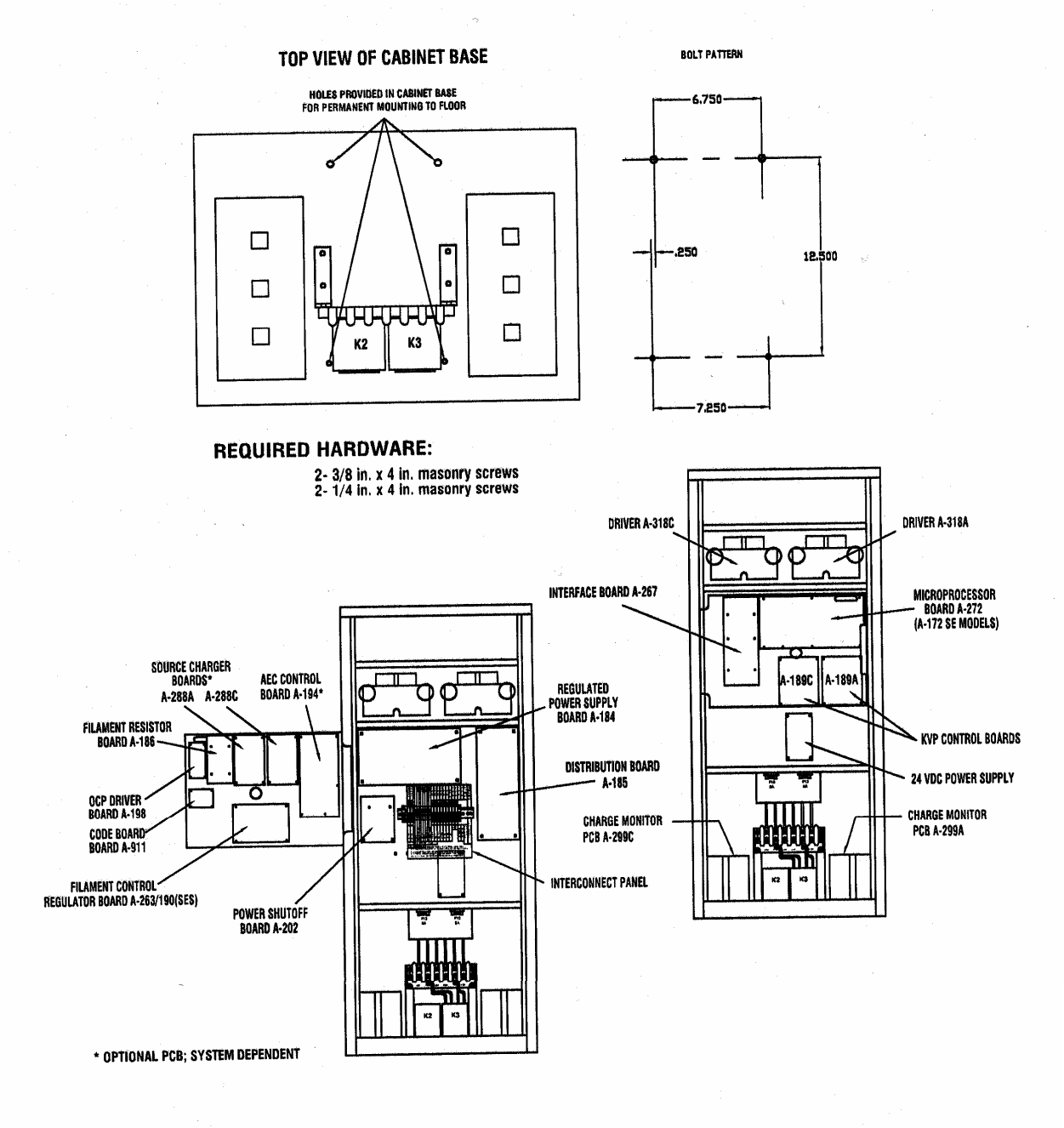

Figure 1 Generator Cabinet

Pre-Installation

continued

OPERATOR CONTROL PANEL	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
ALL MODELS	**20.2 CM 8.0 in**	**24.5 CM 10 in**	**10.2 CM 4.0 in**	**5.18 dm^2 80.3 sq in**	**1.3 kg 2.81 lbs**	**12.11**	**5.26 dm^3 320 cu in**

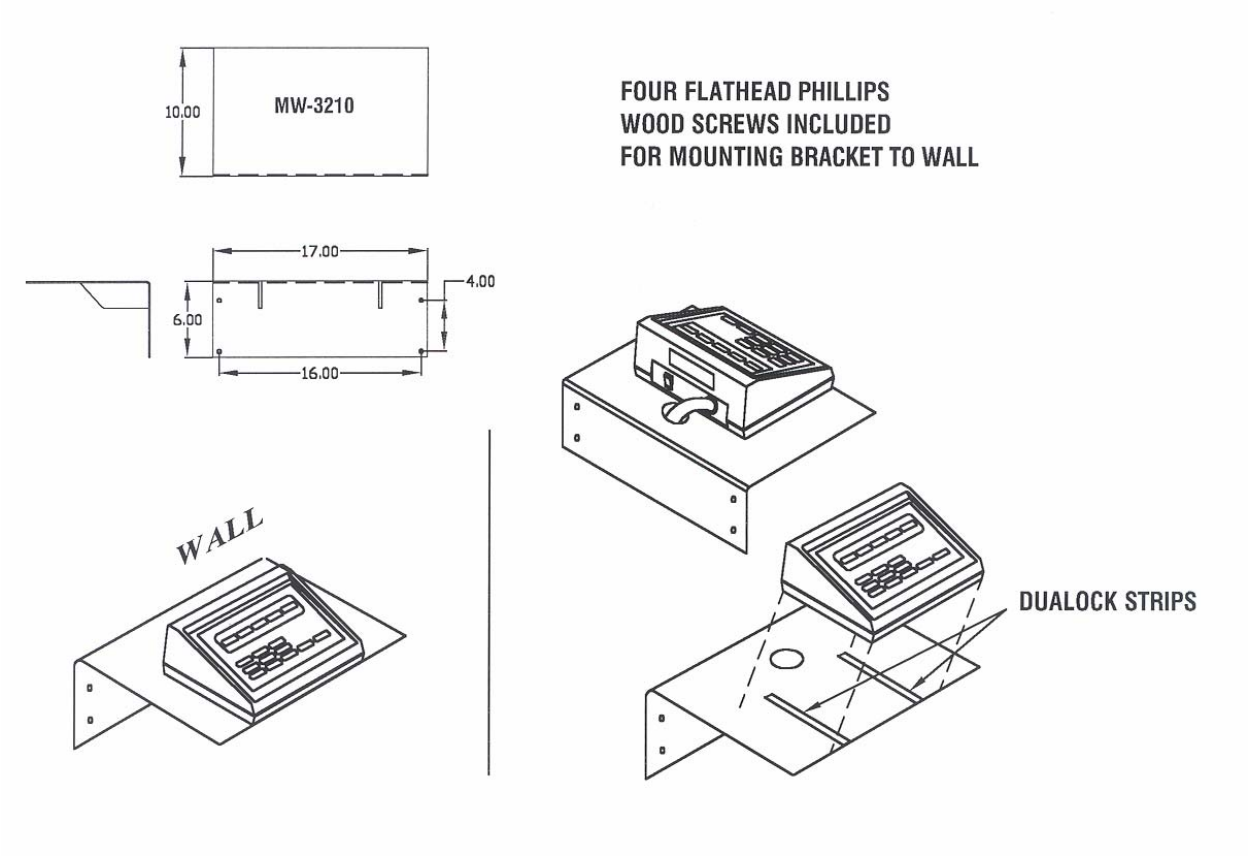

Figure 2 OCP Wall Mount

continued

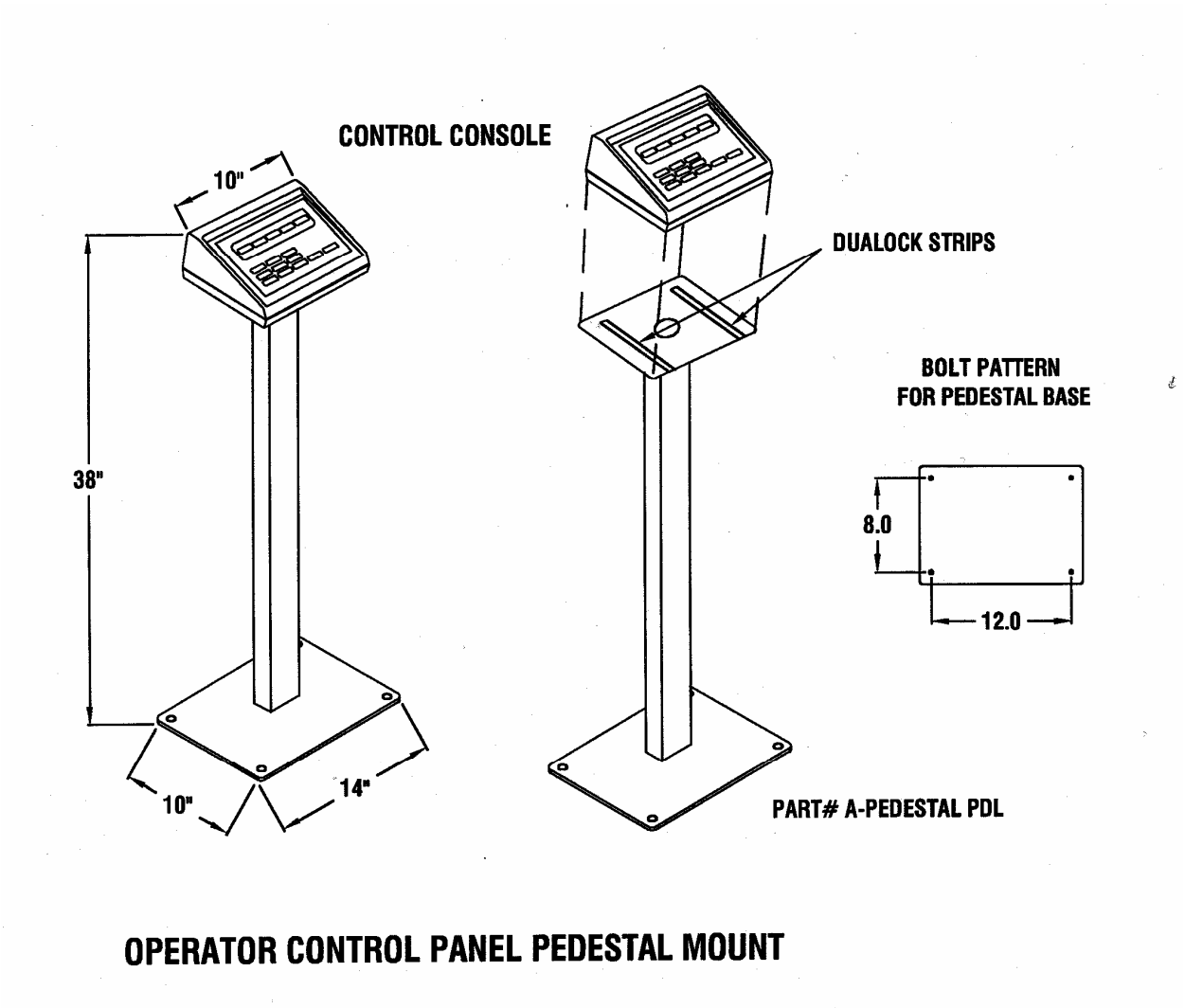

Figure 3 Pedestal Mount

Mounting and Service Area

The recommended mounting of each generator component is:

- Power cabinet with high voltage transformers. Anchor to floor with four M10 (3/8) bolts (not supplied by HCMI, Inc.). (See Figure 1).
- Operators control panel with wall mount shelf (supplied by HCMI, Inc.) (See Figure 2).
- Optional pedestal stand for operators control panel mounting (See Figure 3).

Note: For seismic areas, all components must be secured with anchors specified by local standards.

THE MINIMUM RECOMMENDED FREE AREA FOR SERVICE

COMPONENT	LEFT SIDE	RIGHT SIDE	FRONT	REAR
POWER CABINET HF300/600 HF3 SE/HF3 SEE	0.5 m 20 in	0.5 m 20 in	1.0 m	
OPERATORS CONTROL PANEL	0.1 m 3.9 in	0.1 m 3.9 in	Completely Free	0.1 m 3.9 in

Environmental Requirements (Operating)

Altitude - Temperature - Humidity. All ratings and duty cycles apply to ambient temperature between 10° C (50° F) and 38° C (100° F), average relative humidity not exceeding 90 % and altitude not exceeding 2400 m (8000ft) sea level. Environment must be controlled within these limits.

Heat output of power cabinet with high voltage transformers under normal operating environment can reach 750 watts (2559 BTU). **Do not** store materials on top of power cabinet.

Safety Devices and Exposure Interlocks. The door interlock switch indicates to the operator when doorways to the x-ray room are open. It inhibits the x-ray exposure if room door is open. X-ray warning light is a signal lamp installed outside of the x-ray room near the entrance. The warning light cable should be routed to the power cabinet.

Radiation and Mechanical/Electrical Warning
(from NEMA Standards Publication/No. XR8-1979)

Radiation Warning for Diagnostic X-Ray Systems

X-rays are dangerous to both operator and others in the vicinity unless established safe exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, "Diagnostic X-Ray Systems and their Major Components", and the National Council on Radiation Protection (NCRP) No. 33, Medical S-Ray and Gamma-Ray Protection for Energies up to 10 MeV-Equipment Design and Use, as revised or replaced in the future.

Failure to observe these warnings may cause serious, genetic or potentially fatal bodily injuries to the operator or those in the area.

Mechanical/ElectricalWarning for Diagnostic X-Ray Systems

All of the moveable assemblies and parts of X-ray equipment should be operated with care. Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are deadly; be sure line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels or attaching accessories.

Do not remove the flexible high tension cables from the X-ray tube housing or high tension generator or the access covers from the generator until the main and auxiliary power supplies have been disconnected.

When disconnecting high voltage cables, they must be grounded immediately in order to dissipate any electrical charge that may remain on the cables or the tube.

Failure to comply with the foregoing may result in serious or potentially fatal bodily injuries to the operator or those in the area.

THIS INSTALLATION AND OPERATION MANUAL MUST BE DELIVERED TO THE PURCHASER UPON COMPLETION OF THE INSTALLATION PRIOR TO RELEASE OF THE EQUIPMENT.

INSTALLATION OPERATORS MANUAL

S/N 1000 AND UP
5.0/above Software
REVISION 1
MANUAL # AC-4000 Rev-1

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SECTION A

PREFACE

PREFACE

SECTION A:

INTRODUCTION

Congratulations on selecting the **HCMI, Inc. HF Radiographic System**. This is one of the finest x-ray radiographic system designed for today's market. **HCMI, Inc.** incorporates state of the art technology along with TRUE 100 kHz high frequency resonant power source, anatomically programmable technique selection and Quartz accurate electronics. Your new instrument is designed to provide you with years of service with proper maintenance and care.

MANUAL OVERVIEW

The HF Series Operation Manual is intended for use by technologists and field engineers. Four sections are enclosed. The first four provide the general information and system operation and diagnostic procedures necessary to operate the **HCMI, Inc.** HF 300 system. All other information regarding installation, troubleshooting and schematics can be obtained through our website at www.newhcmi.com or on the CD Rom provided with your system.

- **Section A PREFACE** - includes a system description, safety notices and recommendations, shipping information, compliance and x-ray protection notices and warranty information.
- **Section B GENERAL INFORMATION** - includes component specifications, system options, an overview of operating modes and a description of system controls and indicators.
- **Section C SYSTEM OPERATION -** provides completed operating procedures, including power on/off procedures, operation modes and exposure selection criteria.
- **Section D SYSTEM DIAGNOSTICS** - contains a description of error messages and a list of common system faults with suggested responses.
- **Section E INSTALLATION** – provides installation and interconnection procedures.
- **Section F CALIBRATION** – provides calibration procedures, including kVp, mA, and system electronics.

PREFACE

SYSTEM DESCRIPTION

The **HCMI, Inc.** HF Generator is a anatomically programmable high-frequency x-ray generator. Operating at 100 kHz resonance, the system offers remarkable performance as a diagnostic tool with dramatic reductions in exposure times and patient radiation dose.

The HF series accommodates up to 72 views for 2500 anatomically programmed techniques. After a thickness measurement is entered prior to exposure, the system automatically sets programmed x-ray techniques and exposure factors, including AEC mode (if available), tube selection, bucky selection, kVp, mA, and time. Programmed techniques can be modified at any time through the control panel, either in the actual stored program or during the current exam. During exposure, the AEC (optional) works in conjunction with Auto-Tech to provide uniform, repeatable, high quality images with the smallest variation of optical density between patients.

The HF series is also available as a stored energy system that allows you to plug it into a standard power receptacle (110 VAC).

Standard Configurations and Optional Features

Standard Configurations

The HF Series X-ray generators are state-of-the-art programmable systems. Since the requirements of radiological practices vary widely, **HCMI, Inc.'s** basic system design provides for easy future upgrades. The HF Series is available in four (4) base configurations, as follows:

Single Phase Models:

- HF-300
- HF-600

Stored Energy Models:

- HF-3SE 110 VAC 50/60 Hz
- HF-3SEE 220 VAC 50/60 Hz

Note: Stored Energy models can be connected to a standard 110 VAC or 220 VAC power source.

PREFACE

Optional Features

A variety of options provide the flexibility to meet individual requirements:

- Automatic Exposure Control (AEC) System: uses an ion chamber to assure proper exposure times. The anatomical program selects the kV, bucky, mA and focal spot prior to exposure; the AEC then terminates the exposure at the exact mAs required for a perfect image. This provides uniform film density from patient-to-patient and film-to-film.

- Pedestal Mount (PDL-1000): free-standing unit offers maximum in operator access and convenience.

SAFETY NOTICE

- The HF Series High-Frequency X-Ray generator, manufactured by **HCMI, Inc.** will function reliably when operated, maintained, and repaired according to the instructions provided in this manual.

- **HCMI, Inc.** cannot assume responsibility for any malfunctioning of this equipment resulting from improper operation, maintenance, repair, or from damage or modification of its components.

- This equipment can be hazardous to both patient and operator unless established safe exposure factors are observed.

- X-ray equipment is sold to be used exclusively by or under the prescribed direction of a person who is licensed by law to operate equipment of this nature.

- **HCMI, Inc.** disclaims all responsibility from any injury resulting from improper application of this equipment.

PREFACE

Safety Recommendations

Mechanical/Electrical

All moveable assemblies and parts of this equipment must be operated with care. Manufacturer's equipment recommendations described in this manual (included with equipment) must be observed.

Routine inspection of these assemblies should be performed by qualified service personnel on an annual basis. Only properly trained service personnel should be permitted access to internal assemblies, as live electrical components may be present. Be sure line disconnect switches are open or other appropriate safety precautions are followed before service work is performed.

Failure to follow manufacturer's or service personnel's recommendations may result in serious injury.

CAUTION: This equipment contains electrostatic sensitive devices. Observe proper grounding precautions before handling components or PCB's.

WARNING: GROUNDING: this equipment is grounded to an earth ground through the electrical power cord ground wire. It must be connected into a properly grounded electrical box. Under no circumstances should it be operated without the proper three wire power cord attached.

COMPLIANCE NOTICE

The certified model **HCMI, Inc.** x-ray system you have purchased has been designed, manufactured, and calibrated to comply with governing Federal Regulations 21 CFR Subchapter J and the performance standards attendant thereto.

Scheduled maintenance is essential to the assurance of continued integrity of this equipment with respect to regulatory compliance. The continuance of certified performance to the regulatory standard is incumbent upon the user's diligent conformance to recommended maintenance instructions.

Upon installation, all certified products require the filing of Form FD-2579 "Report of Assembly of a Diagnostic X-Ray System" by the Assembler (i.e., the installer) with the appropriate agencies; the "Installation Quality Assurance Checklist" must be completed and properly distributed upon installation. A copy of each form (pink copy) is provided to the user. The Installation Report is also completed by the installer and returned to **HCMI, Inc.**

Note: Form FD-2579 is required for US installations; please observe the applicable regulations of your particular local and/or national agencies.

PREFACE

X-Ray Protection Notice

X-ray equipment may cause injury if used improperly. The instructions in this manual must be adhered to when operating the HF series. **HCMI, Inc.'s** authorized dealers will assist you in placing your system into operation.

Personal radiation monitoring and protective devices are available. You are urged to use them to protect against unnecessary x-radiation exposure.

It is important that you be fully acquainted with applicable government radiation protection regulations. Many provisions of these regulations are based on recommendations of the National Council of Radiation Protection and Measurements. Recommendations for medical x-ray protections are published in NCRP Report Number 102, available from:

NCRP Publications
7910 Woodmont Ave. Suite 1016
Bethesda, MD 20814

Those responsible for the planning of x-ray equipment installations must be thoroughly familiar and comply completely with NCRP #49, "Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma-Rays of Energies up to 10 MEV", as revised or replaced in the future.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure techniques and procedures described in publications such a Subchapter J of Title 21 of the code of Federal Regulations, "Diagnostic X-Ray Systems and Their Major Components", and the NCRP Report 102 referenced above, as revised or replaced in the future. Failure to observe these warnings may cause serious injuries.

SHIPPING INFORMATION

- The manufacturer is relieved of any responsibility for damage during shipment after the unit is picked up by the carrier.
- Examine all cartons and crates carefully at time of delivery. If damage is apparent, have delivery driver write a "Damaged Shipment Note" on copies of the freight bill, sign it, and file the appropriated carrier claim. Should you discover concealed damage, immediately notify the transporting agent and ask for an "Inspection of Damage". Carrier will not accept concealed damage claim if filed after 15 days from date of receipt of merchandise.
- Open crate or carton marked "packing list enclosed" first. Remove packing list and use as guide to open remaining cartons. Do not dispose of packing material until packing list is matched with actual parts received. Should there be a shortage or damage, notify the manufacturer immediately.
- Shipping storage limits: Ambient Temperature: 10C (50F) to 38C (100F): Relative Humidity: 0 to 85% non-condensing: Operating Altitude: 0 to 2400m (8000 Ft.)
  Environment Must Be Controlled Within Limits

PREFACE

Guarantee

Providing the warranty card (s) are completed and returned to the manufacturer within fifteen (15) days after receipt of the equipment, **HCMI, Inc.** warrants to Buyer that any new product manufactured by **HCMI**, **Inc.** ("Product") will (1) be free from defects in material and manufacturing and (2) conform substantially to applicable specifications in effect on the date of shipment when subjected to normal, proper and intended usage by properly trained personnel. The criteria for all testing shall be the applicable specifications, utilizing factory-specified calibration and test procedures and instruments.

- **ALL PRODUCT WARRANTIES AND ALL REMEDIES FOR WARRANTY FAILURES ARE LIMITED IN TIME AS LISTED BELOW.**

Duration of Guarantee

SEE GUARANTEE (WARRANTY) CERTIFICATE FOR DURATION

Any component furnished without charge to Buyer during the warranty period to correct a warranty failure shall be warranted only to the extent of the unexpired term of the warranty of the original product. This warranty extends only to the original purchase and is not transferable unless authorized in writing by **HCMI, Inc.**

GUARANTEE/WARRANTY TERMS AND CONDITIONS

Warranty consideration will be given only for products properly returned to the **HCMI, Inc. factory** in accordance with **HCMI, Inc.'s** warranty/guarantee return procedure.
A fully completed Returned Goods Authorization/Service Report must be returned with the defective item(s), if applicable. All shipping charges resulting from warranty returns are the responsibility of the Purchaser or Dealer.

- **An item "serial number" must be given to facilitate any warranty claim.**

BUYERS REMEDIES

If **HCMI, Inc.** determines that any Product fails to meet any warranty during the applicable warranty periods, **HCMI, Inc.** shall correct any such failure either at its option (a) by repairing, adjusting, or replacing any defective or nonconforming Products, or defective or damaged part of parts of the Product or (b) by making available at the place of assembly any necessary repaired or replacement parts or assemblies. **HCMI, Inc.** shall have the option to furnish either new or exchange replacement parts or assemblies. All replaced parts shall become the property of **HCMI, Inc.**

Installation, troubleshooting or repair service is not included in this warranty/guarantee.
Warranty of service is the responsibility of the dealer selling the equipment.

SEE WARRANTY CERTIFICATE FOR COMPLETE TERMS AND CONDITIONS OF WARRANTY/GUARANTEE AS STATED BY MANUFACTURER.

SECTION B

GENERAL INFORMATION

GENERAL INFORMATION

HF Series Generator Specifications

This section contains system specifications and technical data for the HF generator, controls and indicators for the Operator Control Panel.

DIMENSIONS

Power Cabinet	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
HF300	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**148 kg 325 lb**	**2559**	**378.62 dm³ 23105 cu in**
HF600	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**148 kg 325 lb**	**2559**	**378.62 dm³ 23105 cu in**

Stored Energy	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
HF3 SE	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**183 kg 402 lb**	**2661**	**378.62 dm³ 23105 cu in**
HF3 SEE	**43.2cm 17 in**	**60.9cm 24 in**	**142 cm 56 in**	**26.35dm² 408 sq in**	**183 kg 402 lb**	**2661**	**378.62 dm³ 23105 cu in**

OPERATOR CONTROL PANEL	LENGTH	WIDTH	HEIGHT	FOOTPRINT	WEIGHT	BTU	VOLUME
ALL MODELS	**20.2 CM 8.0 in**	**24.5 CM 10 in**	**10.2 CM 4.0 in**	**5.18 dm² 80.3 sq in**	**1.3 kg 2.81 lbs**	**12.11**	**5.26 dm³ 320 cu in**

Specifications Overview

kVp Range: 40-125 kVp in 1 kVp steps
kVp Accuracy: ± 5%
mA Range: Model dependant (see table B-1)
mA Accuracy: ± 10% or 5 mA, whichever is greater
Time Range: 5 milliseconds to 6 seconds, over 200 steps
Time Accuracy: ± 1% ± 3 milliseconds. Time is measured at the 90% level of the peak kV
mAs Accuracy: ± 1% for time greater than or equal to 100 milliseconds and current greater than or equal to 50 mA; otherwise, accuracy is a product of time and mA accuracies
Duty Cycle: 1% of full load or x-ray tube limits, whichever is less
Heat Energy Output: AVG. 1936 BTU/hr
kW Output: - HF 300 = 30 kW - HF 600 = 37.5 kW - HF 3SE = 30 kW
- HF 3SEE = 30 kW

♦ **Note: Specifications for all configurations are identical, except as noted in chart and power requirements. All specifications do not include measurement instrumentation accuracy.**

GENERAL INFORMATION

Specifications Overview continued

MODEL		SPECIFICATIONS			
		MAXIMUM KW	KW @ 100KV @ 0.1 SEC	KVP RANGE 1 KVP STEPS	MA STATIONS S= small focus L= large focus
SINGLE PHASE	HF 300	30	30	40-125	25S 75S 150S 150L 200L 250L 300L
	HF 600	37.5	30	40-125	25S 75S 150S 200L 300L 400L 500L 600L
STORED ENERGY	HF3SE	30	30	40-125	25S 75S 150S 150L 200L 250L 300L
	HF3SEE	30	30	40-125	25S 75S 150S 150L 200L 250L 300L

Table B-1 Generator Specifications

GENERAL INFORMATION

Power Requirements

For any electrical installation, all electrical wiring/connections must be installed by a qualified electrician and conform to national and local codes. Requirements for health care facilities (National Electric Code NFPA No. 70) must be followed. Common power specifications are described below and configuration dependant electrical requirements are listed in Figure 2-0, page 6 Sec B.

General Electrical Compliance Requirements

These general guidelines must be followed in order to comply with the National Electric Code:

- **All wiring must be copper.**
- Insulation rating of the wire must be at least 50% of momentary current (as listed in Figure 2-0, HF Electrical Requirements).
- All fuses, circuit breakers and disconnect switches should conform to the above requirement of 50% of momentary current; the **Disconnect Switch is to be located within reach of the operator.**
- For all installations, a separate earth ground (#6 AWG insulated wire) must be installed. This #6 AWG insulated wire must be the ***ONLY*** wire connected to the ground terminal.

Power Specifications (Single Phase Input Units)

Specification	HF-300	HF-600
Input voltage: configured at time of installation	200-250 VAC 50/60 Hz	200-250 VAC 50/60 Hz
Long Term Amps	5 amps	5 amps
Momentary Amps	225 amps RMS	250 amps RMS
Line Regulation	7% at full load	7 % at full load
Line Voltage Compensation	Fully automatic, max. overall line voltage variations (non-equip related) not to exceed 7%	Fully automatic, max. overall line voltage variations (non-equipt related) not to exceed 7%

Table 2-1. Power Specifications for Single Phase Input Units

Power Specifications continued

Power Specifications (HF 300 600 Models) listed in Table 2-1 on page 4 Sec B and (HF 3SE 3SEE) listed in Table 2-2 below.

Specification	HF-3SE	HF-3SEE
Input voltage: configured at time of installation	105-130 VAC 50/60 Hz	200-250 VAC 50/60 Hz
Long Term Amps	Less than 6 amps	Less than 3 amps
Momentary Amps	Less than 20 amps during rotor start up time	Less than 10 amps during rotor start up time
Line Regulation	10% at 20 amp load	10 % at 10 amp load
Line Voltage Compensation	Fully automatic, max. overall line voltage variations (non-equip related) not to exceed +/- 5%	Fully automatic, max. overall line voltage variations (non-equipt related) not to exceed +/- 5%

Table 2-2. Power Specifications for Stored Energy Units

GENERAL INFORMATION

Electrical Requirements

MODEL	VOLTAGE 50/60 HZ LINE REGULATION 7% AT FULL LOAD	WIRE SIZE LENGTH TO ROOM DISCONNECT				DISCONNECT TO GENERATOR 15 FEET MAXIMUM	MOMENTARY LINE CURRENT	SERVICE RATING	MAXIMUM LINE RESISTANCE OHMS
		50 FEET	100 FEET	150 FEET	200 FEET		AMPS	AMPS	
HF 300 30 KW SEE NOTE	208	#1 AWG	2/0 AWG	3/0 AWG	250 MCM AWG	#4 AWG	225	110	.08
	220	#1 AWG	1/0 AWG	2/0 AWG	4/0 AWG		210	100	.08
	240	#2 AWG	#1 AWG	2/0 AWG	3/0 AWG		195		.10
	250	#2 AWG	#1 AWG	1/0 AWG	2/0 AWG		180		.15
HF 600 37.5 KW SEE NOTE	208	1/0 AWG	3/0 AWG	4/0 AWG	300 MCM	#2 AWG	250	120	.04
	220	#1 AWG	1/0 AWG	3/0 AWG	250 MCM		240		.04
	240	#1 AWG	1/0 AWG	2/0 AWG	3/0 AWG		220	110	.05
	250	#2 AWG	#1 AWG	1/0 AWG	2/0 AWG		200	100	.08
HF 3SE Stored Energy 30 KW	105 TO 130	50/60 HZ	3 WIRE POWER CORD 20 AMPS					6 AMPS LONG TIME	LINE RES. N/A
HF 3SEE Stored Energy 30 KW	220 TO 240	50/60 HZ	3 WIRE POWER CORD 10 AMPS					3 AMPS LONG TIME	LINE RES. N/A

NOTE: INPUT CURRENT: LESS THAN 5 AMPS LONG TERM: MAXIMUM LINE CURRENT MEASURED AT 125 kVp AT MAXIMUM kW OUTPUT OF THE GENERATOR.

***ALL WIRE MUST BE COPPER**
****ALL GROUNDS MUST BE #6 AWG**

Electrical Requirements continued

For any electrical installation, all electrical wiring/connections must be installed by a qualified electrician and conform to national and local codes. The guidelines listed below must be followed in order to comply with the National Electric Code:

- All wiring must be copper
- Insulation rating of the wire must be a least 50% of momentary current (as listed in Figure 2-0, page 6, Sec B, Electrical Requirements.
- All fuses, circuit breakers and disconnect switches should conform to the above requirement of 50% of momentary current; the disconnect switch is to be located within reach of the operator.
- For all installations, a separated earth ground (#6 AWG insulated wire) must be installed. This #6 AWG insulated wire must be the **only** wire connected to the copper ground terminal.

Requirements for health care facilities (National Electric Code NFPA No. 70) must be followed.

GENERAL INFORMATION

Tube and Collimator Compatibility

Tube: HCMI, Inc: BXT Series
Toshiba: E72 Series

Note: For tube types not listed, consult factory.

Collimator: HCMI, Inc./EUREKA LINEAR MC-150

HF generators are compatible with any automatic collimating system that provides an isolated normally open switch which closes when the Automatic Collimation System presents an "Exposure Ready" mode to the control; they are also compatible with any beam limiting device that complies with 21 CFR Subchapter J intended for radiographic equipment other than general purpose radiographic systems.

Operator Control Panel

The separate Operator Control Panel (shown in Figure 2-2) allows complete control and access to all system functions and features. A twenty-one button touch-sensitive key pad combined with a Liquid Crystal Display (LCD) and Light Emitting Diode (LED) technology provide user-friendly control and indication of system status. Controls and indicators described in the following paragraphs can be referenced to Figure 2-2, HF Series Operator Control Panel.

Display and Indicators

LCD Panel: Displays techniques of corresponding selection keys providing a pre-indication of kVp, mA, Time and mAs as well as measured thickness of the Region of Interest (ROI) in cm.

LED Indicators: A lit indicator lamp indicates an activated function.

Direction Keys: Pressing either the **UP** or **DOWN** arrow key (located above or below the LCD display) will increase or decrease the corresponding factors, respectively.

Ready Indicator: This LED illuminates when the system has performed all of its self-checks and is ready to take an exposure.

Mode Selection Keys

Manual Key: Allows for manual selection of all technique factors/parameters without automatic system intervention.

AEC Key: Selects the optional Automatic Exposure Control (AEC) function. **AEC** uses an ion chamber to assure proper exposure times.

Mode Selection Keys continued

Auto-Tech Key: This key enables the Auto-Tech mode. After pressing Auto-Tech, the LCD displays the eight (8) available anatomical regions for selection. After selection of an anatomical region, up to nine available programs for the selected region are displayed. Once a program is selected, the system automatically performs the following functions:

- selects tube, bucky, and SID required for selected view
- selects the kV and mA programmed for the anatomical thickness selected
- selects chamber, field(s), film speed, and back up time if AEC is enabled

These technique factors are used by the microprocessor to set the phototimer that terminates the exposure at the proper mAs for uniform optical density.

- selects mAs if AEC is disabled

Bucky Selection Keys

Wall Bucky Key: This key selects the wall grid and AEC chamber, activating the wall bucky, if present. This function can be programmed to activate when wall bucky techniques are used in the Auto-Tech program.

Non-Bucky Key: This key allows for techniques that do not use a bucky. The LED illuminates when "NONE" is selected. This function can be programmed to activate if a non-bucky technique is used in an Auto-Tech program.

Table Bucky Key: This key selects the grid and AEC chamber, activating the bucky, if present. This function is automatically activated if "TABLE" is used in an Auto-Tech program.

AEC Field Selection Keys: These keys select the field or combination of fields used to sense the amount of radiation entering the film cassette. The operator selects the key with the appropriate configuration of AEC field symbols. A shaded or hollow box indicates whether a field is used or unused.

GENERAL INFORMATION

Utility Keys

Prep Key: Boosts tube filament and rotor, checks all data lines.

Expose Key: Pressing this key initiates the exposure.

NOTE: This system incorporates many fail-safe devices (both mechanical and electrical) to protect patients and technologist. If a microprocessor failure should occur during an exposure, the operator control may be locked out with any or all indicators illuminated at random. In this case, fail-safe devices are activated and all x-ray emission is terminated instantly.

Power Controls

Remote Power Switch: The system can be powered **on** or **off** by this switch without using the main circuit breaker. In addition, system can be re-set with this switch after automatic power-off feature shuts the system down. It is located on the OCP.

WARNING: DO NOT ATTACH BRACKETS, MOUNT EQUIPMENT OR DRILL HOLES IN THE POWER CABINET PANELS OR FRAME. DOING SO WILL VOID THE WARRANTY AND COMPLIANCE TO UL 2601-1-2

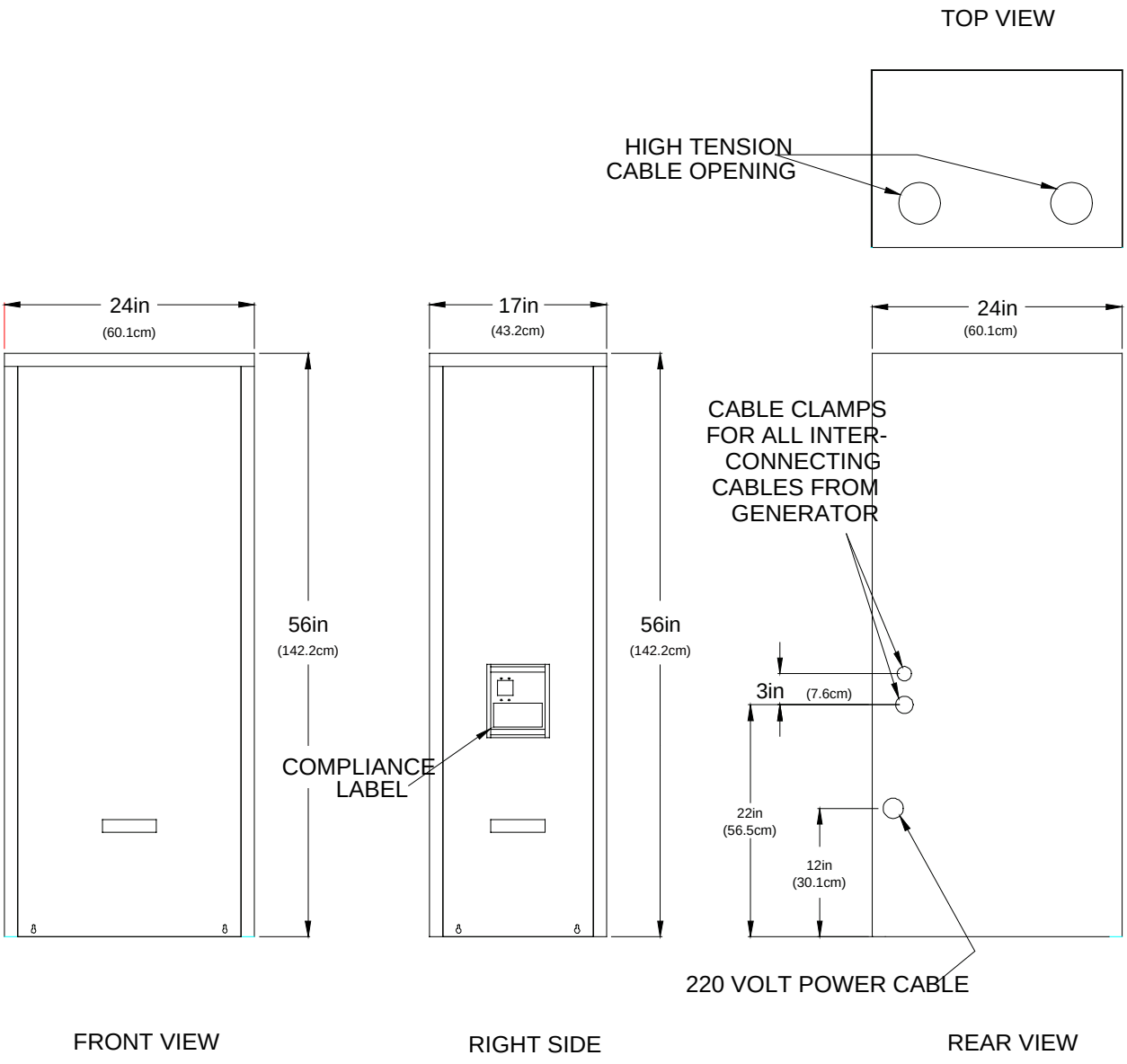
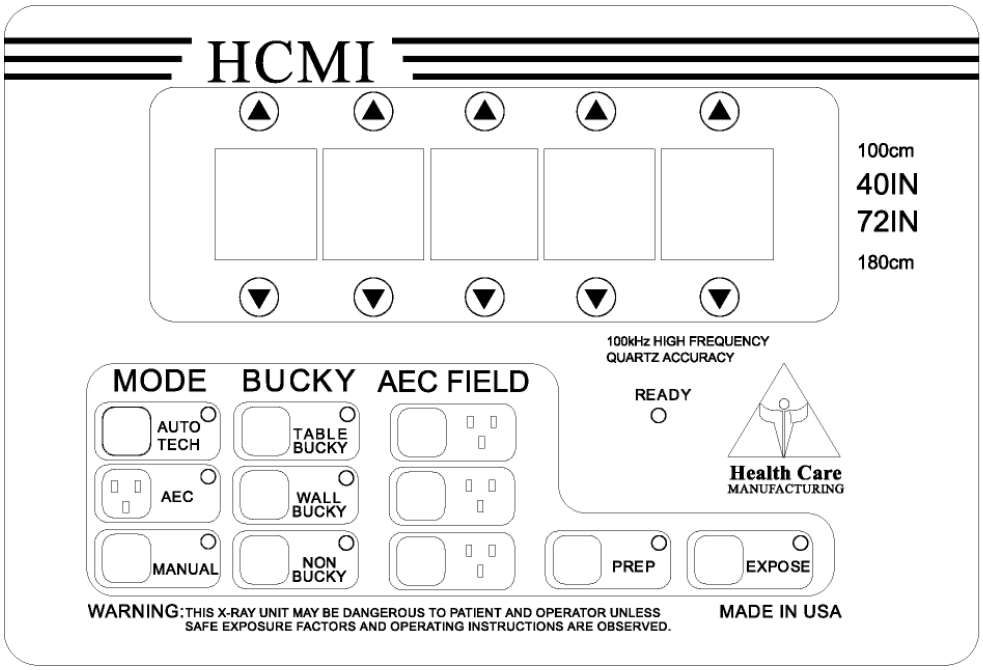


Figure 2-1 HF Series Generator and OCP Dimension

GENERAL INFORMATION



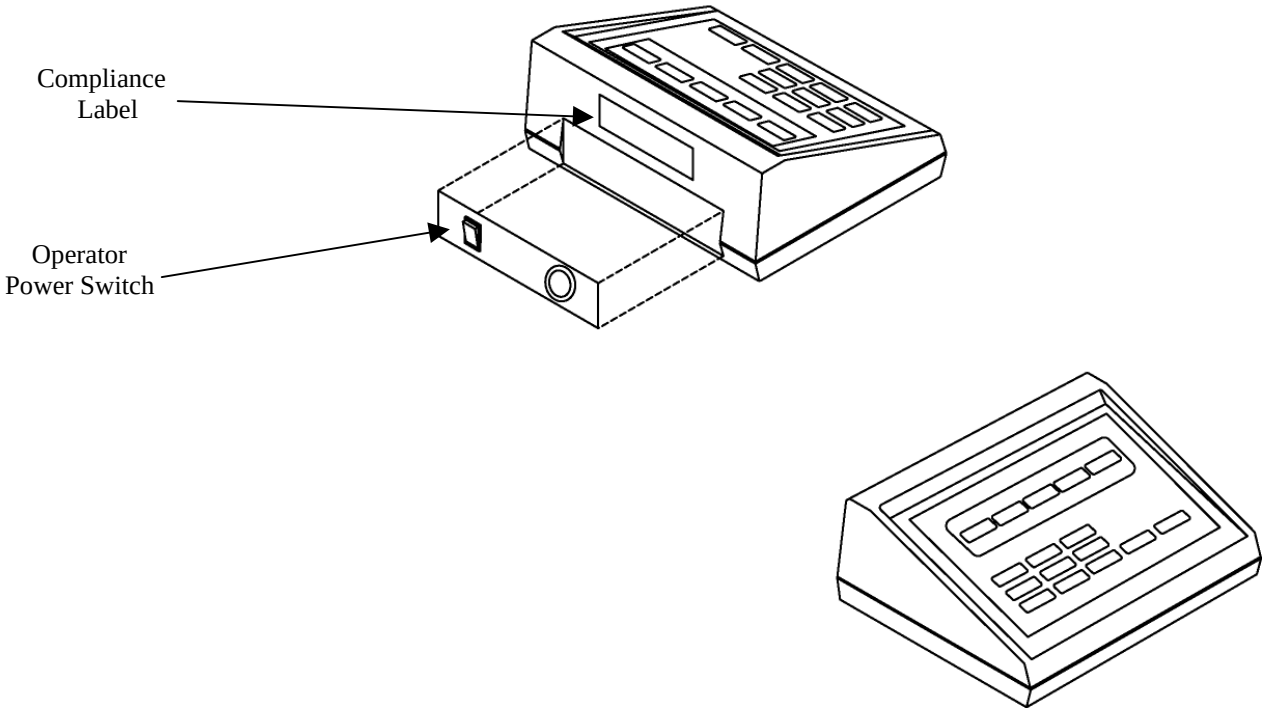


Figure 2-2 HF Series Operator Control Panel

GENERAL INFORMATION

Warning: Never attempt to clean or touch any part of the x-ray generator's internal components when power is turned on. Switch off disconnect circuit breakers before cleaning.

General Cleaning

External Surfaces

Clean external covers and surfaces, particularly if corroding chemicals are present, with a cloth moistened in warm water with mild soap. To rinse, wipe with a cloth moistened in clean water. Never use cleaners or solvents of any kind. Also check painted surfaces and touch up as required.

Internal Cabinet Cleaning

Remove power cabinet panels.

Caution: Make sure that storage capacitors do not contain any residual charge.

Visually inspect all areas for dust and foreign items. Carefully check for materials that could cause shorts and remove them. If excess dust is present remove with air or vacuum cleaner.

Replace all safety covers and access panels before applying power.

System Description

HCMI, Inc. Generators described in this service manual comply with all the standards shown on the label on page 13 of this section. Models listed in this manual are Class 1 equipment, type B protection against shock. Generator models are ordinary medical equipment with enclosed equipment cabinets without protection against ingress of liquids.

Mode of operation: All models are intermittent and classified as suitable for continuous connection to the power supply mains. HCMI, Inc. Generator models are not suitable for use in the presence of a flammable anesthetic mixture with air, oxygen or nitrous oxide.

GENERAL INFORMATION

System Description continued

<table>
<tr><td>Health Care Manufacturing, Inc.
2146 E Pythian
Springfield, MO 65802</td><td colspan="2">X-RAY EQUIPMENT</td></tr>
<tr><td>MODEL: HF-300
Serial No: HCG-1151

Volt: 200-250 VAC 50/60Hz.
Amp MOM: 225 RMS Amp L.T.5
Max kVp: 125 Max mA: 300
Apparent Res. .10 OHMS
Output: 30kW</td><td>CLASSIFIED
C UL US

35YN</td><td>UL 2601-1
IEC 60601-1-2
IEC 60601-2-7
CAN/CSA C22.2
NO. 601.1</td></tr>
<tr><td>Manufactured: Dec 2001</td><td colspan="2"></td></tr>
<tr><td colspan="3">Complies with FDA radiation performance standards, 21 CFR Subchapter J,
Applicable at date of manufacture.</td></tr>
</table>

X-RAY EQUIPMENT

CLASSIFIED WITH RESPECT TO ELECTRIC SHOCK, FIRE AND MECHANICAL HAZARDS ONLY IN ACCORDANCE WITH UL 2601-1.

35YN

SECTION C

SYSTEM OPERATION

SYSTEM OPERATION

Overview

This section provides the information necessary to operate the HF Series High-Frequency x-ray generator.

The following operating procedures are outlined and described in detail:

- Power **on/off** procedures
- Seasoning procedures
- Operating modes and selection: Auto-Tech, AEC and Manual
- Printing techniques

Power On/Off Procedures

The following are step-by-step procedures to **power-on/off** your system according to its status. There are three possible shut down states:

1. Complete Shut Down- The power switch and main circuit breaker were set to off. The power line might have been disconnected
2. Remote Shut Down- The system was shut down with the remote **ON/OFF** power switch on the Operator Control Panel (OCP).
3. Automatic Shut Down- Power to the system was automatically disconnected (via internal timing circuit) after sixty minutes of inactivity.

To Power-on Your System:

From A Complete Shut Down

1. If necessary, connect the power line into the appropriate power receptacle.
2. Set the main circuit breaker on the system to the **ON** position.
3. Set the remote power switch (located on the OCP) to the **ON** position.

From A Remote Shut Down

1. Set the remote power switch to the **ON** position

From An Automatic Shut Down

1. Set the remote power switch to **OFF**.
2. Wait five seconds, then set the remote power switch to **ON**.

SYSTEM OPERATION

Power-On Self Test

- When the HF Series generator system is first powered-on, **"HCMI"** appears on the display while the system automatically runs a series of self checks to ensure proper operation. If an error is detected, the actual error (i.e., **"DOOR?"**) will appear on the LCD. Upon successful completion of the self checks, the display will return to the last exposure setting that was used.

To Power-Off Your System

For Short Periods of Time

1. Set the remote power switch on the OCP to the **OFF** position.
2. Ensure indicators are dark. System is now shut down.

For Long Periods of Time

1. Set remote power switch on the OCP to the **OFF** position.
2. Locate the main circuit breaker on the generator and set to the **OFF** position.
3. If desired, unplug the power line from the power receptacle or set the main power disconnect switch to the **OFF** position. System is now shut down.

Automatic Power-Off Feature

To help save power and protect system electronics when left unattended, the HF Series generator system is equipped with an automatic power-off feature that shuts down the unit.

After approximately sixty minutes of inactivity, the system will automatically power-off through software control, leaving all switches in the **ON** position.

An audible tone will be emitted for approximately 30 seconds before the system shuts down and **"PRESS ANY KEY"** will be displayed on the operator control panel.

To Abort the Automatic Power-Off Feature: **Press any key on the operator control panel.**

To Re-start after Automatic Shut Down: **Refer to Power-On Procedures.**

Full Charge Shutdown (Stored Energy Only)

Occasionally, when the system has not been used for an extended period of time, or after a period of heavy use, a full charge shut-down is recommended. A full charge will help to restore the batteries to a sufficiently-charged condition.

1. Press arrow keys (See Figure 6-11, page 7 Sec F).
2. Leave the system in this state until the next day.
3. The next day, press **MANUAL** on the Utility Menu. System is ready for use.

Daily Procedures

Warm-Up Procedures

All tube manufacturers recommend seasoning procedures upon installation and daily warm-up. Systems used infrequently should have tubes seasoned on a daily basis. It is important that these procedures be performed to maintain both the tube manufactures and HCMI, Inc.'s extended warranties.

A typical daily seasoning procedure is provided below. If the system has not been used for several days, or upon installation, refer to the tube manufacturer's instructions.

Procedure:

Table 3-1 Exposure Settings for Seasoning Procedures

EXPOSURE NUMBER	KVP	TIME (Seconds)
1	**50**	**0.1**
2	**60**	**0.1**
3	**70**	**1.0**
4	**80**	**0.1**
5	**90**	**0.1**
6	**100**	**0.1**
7	**110**	**0.1**

SYSTEM OPERATION

Operating Modes

The HF Series can operate in four modes:

- Manual
- Automatic Exposure Control (AEC)
- Auto-Tech
- Auto-Tech with AEC

MANUAL MODE - requires manual calculation/selection of all x-ray techniques and exposure factors.

AEC MODE - (optional) uses an ion chamber to ensure proper exposure times. Film density is selectable via key pad control through selection of AEC fields in use and pre-programmed film/screen combinations.

AUTO-TECH MODE - enhances radiographic imaging by automatically setting technique factors. After a thickness measurement is entered, prior to exposure, the system automatically sets programmed x-ray techniques and exposure factors including AEC mode (if available), tube selection, bucky selection, kVp, mA, and time. Programmed Auto-Tech settings can be modified at any time through the OCP, either in the actual stored program or for the current exam. During exposure the AEC (optional) works in conjunction with Auto-Tech to provide uniform, repeatable, high quality images with the smallest variation of optical density between patients.

AUTO-TECH WITH AEC MODE - after the technologist selects the anatomical view, the system selects and sets all the optimum technique factors prior to exposure, including the wall or table ION chamber.

Setting Up To Take Exposures

All aspects of x-ray techniques are entered at the OCP. Prior to taking an exposure, **MODE**, **BUCKY** and **TUBE** must be selected. **In addition**, the displayed exposure factors **(mA, Time, kVp and mAs)** should be verified. When operating in Auto-Tech mode, all x-ray techniques and exposure factors are automatically entered for you.

Pre-Exposure Selections

This procedure outlines step-by-step instructions to set up x-ray techniques and exposure factors prior to exposure. Since these procedures are mode and option dependant, refer to the appropriate operating mode to begin. A flow chart on page 6 (Figure 3-1) provides a graphic representation of the pre-exposure selection process. Selections are made by pressing the appropriate key on the OCP or the UP/DOWN arrows on the LCD portion of the LCD.

Pre-Exposure Selections continued

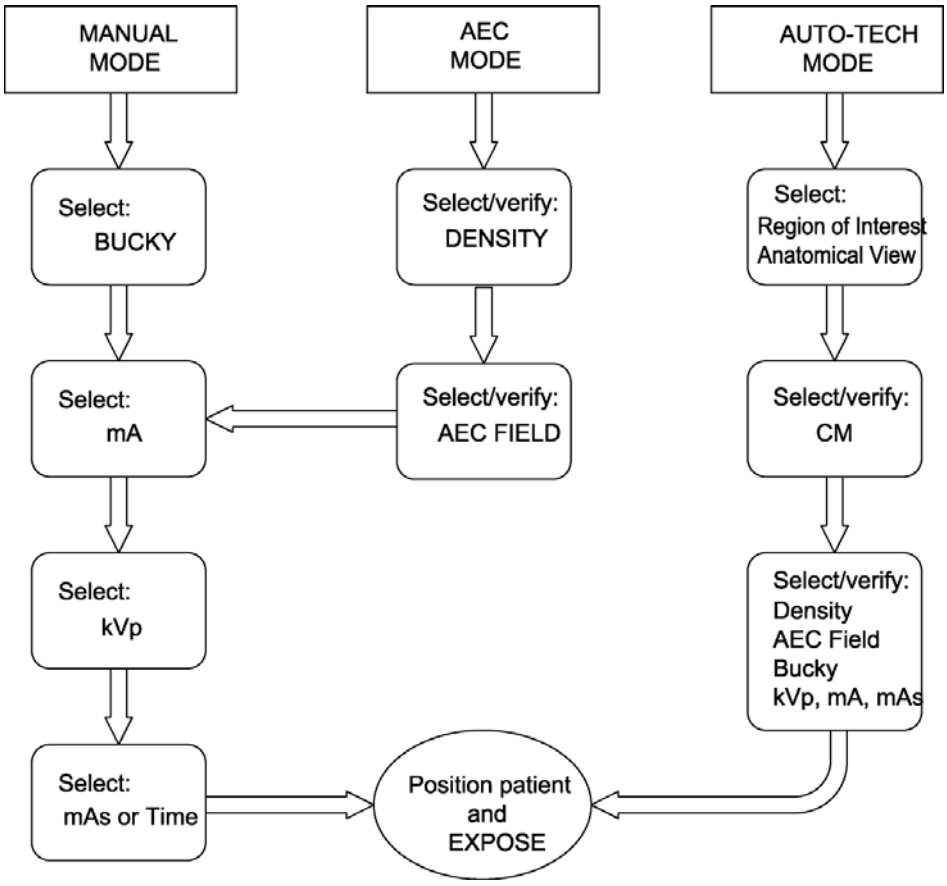


Figure 3-1 Mode Selection Flow Chart

Select an Operating Mode

There are four possible modes of operation, depending on the options selected with your system. The two basic modes are Auto-Tech and Manual. Automatic Exposure Control (AEC) can be used as a stand alone mode (by itself) or in conjunction with Auto-Tech.

1. Select a mode of operation by pressing the appropriate key: AUTO-TECH, AEC, or MANUAL.
2. Once selected, ensure that the corresponding indicator is illuminated.
3. Continue with the required procedures as follows:

AUTO-TECH Selected	Go to Select Region of Interest
AEC Selected	Go to Select Density
MANUAL Selected	Go to verify/Select Tube and Bucky

Select Region of Interest

When Auto-Tech is selected, x-ray techniques and exposure factors are automatically set according to your specific program. The Auto-Tech Menu (example shown in figure 3-2, below) will be displayed on the LCD.

1. Select the appropriate region of interest by pressing UP or Down sector key associated with the desired region.

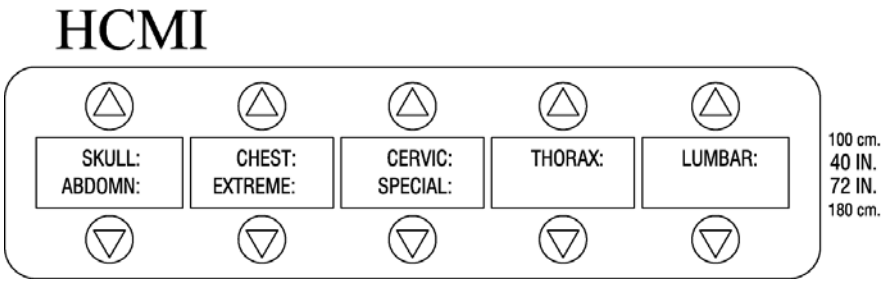


Figure 3-2 Auto Tech Menu

Select an Anatomical View

After the region of interest is selected, a selection of available anatomical views will be displayed.

1. Select the appropriate anatomical view by pressing the UP or DOWN sector key associated with the desired view (see figure 3-3). Anatomical names and/or designations can be modified, added or deleted from the program as described in Section G, Programming.

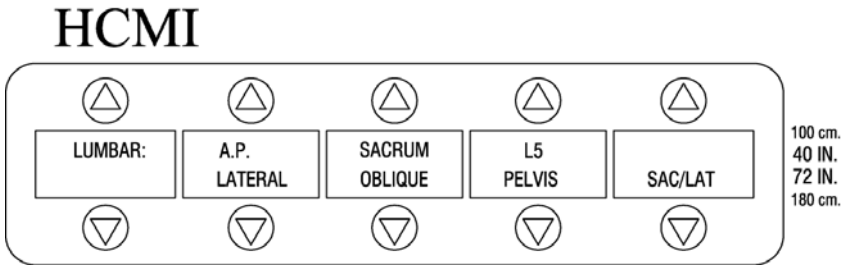


Figure 3-3 Anatomical View Selection Menu

Verify/Select Measurement

Selected SID is indicated by arrow as shown in Figure 3-4.

1. If necessary, use the UP/DOWN sector keys on the LCD to increase or decrease the displayed cm. Initially, the CM value is set to 0.
2. If AEC mode is available continue with Enter/Verify CM.

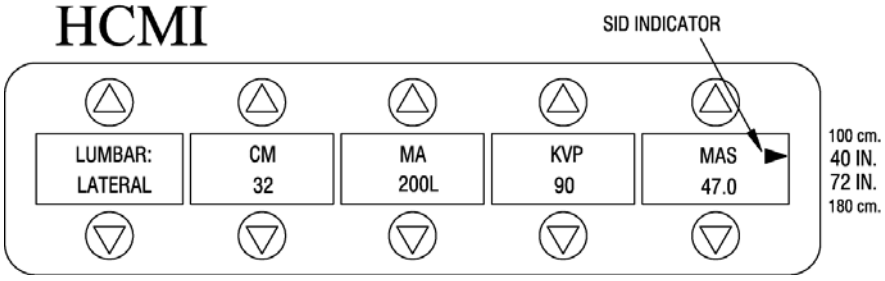


Figure 3-4 AEC Mode

Verify/Select AEC Density/Field

When AEC is enabled, the AEC mode indicator is illuminated. A segment of the LCD displays the currently selected AEC field and film density setting (example shown in Figure 3-6). Available density settings (DNS value) are from +5 to -5. The 0 (zero) setting is depicted as N (normal), which is the initial setting.

Density

1. To increase or decrease density, press the UP or DOWN sector keys in the DNS field, respectively. Each density step increases or decreases mAs by approximately 15%, which, in turn, increases or decreases density, respectively.

AEC Field

A configuration of three boxes depicted on the LCD displays currently selected fields. A shaded or hollow box indicates whether a field is used or unused, respectively.

NOTE: Ensure that the appropriate BUCKY mode is enabled prior to AEC FIELD selection.

1. To select an AEC field, press one of the AEC Field keys until the desired configuration is displayed on the LCD. There are seven possibilities.

AEC Field Continued

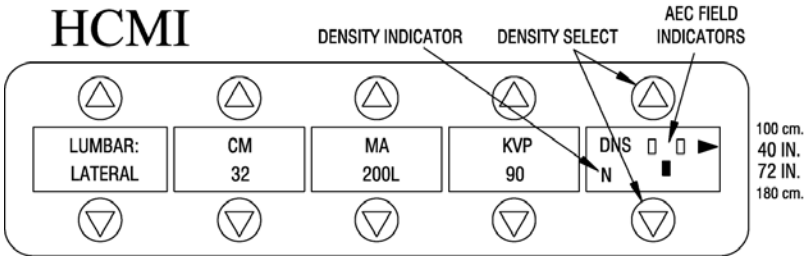


Figure 3-5 Auto Tech Menu (AEC On, AEC Field Select)

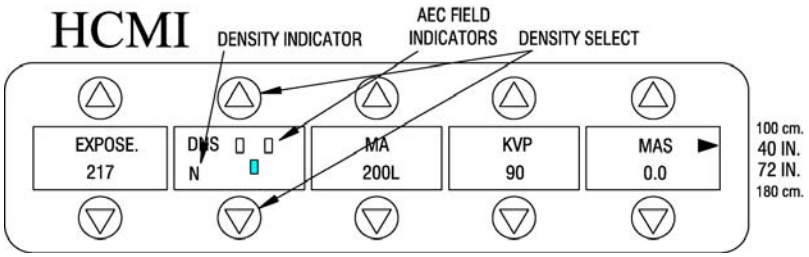


Figure 3-6 AEC Mode Enabled, Field Selection Settings

Verify/Select Bucky

1. In each operating mode, verify that the appropriate Bucky technique is selected (indicator illuminated).

2. If necessary, press the appropriate key: Wall Bucky, Table Bucky, or Non Bucky.

3. Continue with Verify/Select Exposure Factors.

Verify/Select Exposure Factors

In auto-Tech mode, exposure factors (mA, kVp and mAs) are programmed. However, you can modify any displayed factor or enter your own for manual or AEC modes. Once you have verified that all x-ray techniques and exposure factors are correct, you can prepare to take an x-ray exposure.

Displayed exposure factor values (see example displays below) can be increased or decreased by pressing the **UP** or **DOWN** arrow keys associated with the factor. When techniques are modified from the original settings, **UP/DOWN** arrows are displayed next to the modified technique to indicate that its corresponding factor was increased or decreased. For example, as shown in Figure 3-8, mA was increased, kVp was decreased and mAs were decreased.

Note: Values displayed are not necessarily correct techniques; they are used only as an example.

Verify/Select Exposure Factors continued

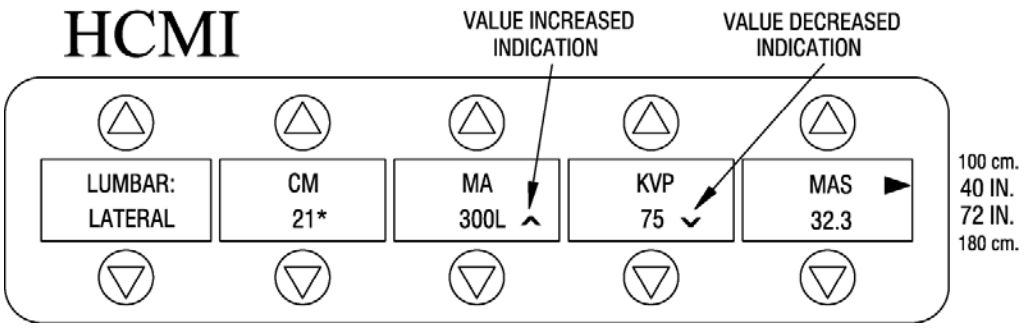


Figure 3-7 Initial Auto-Tech Menu, Manual CM Entry

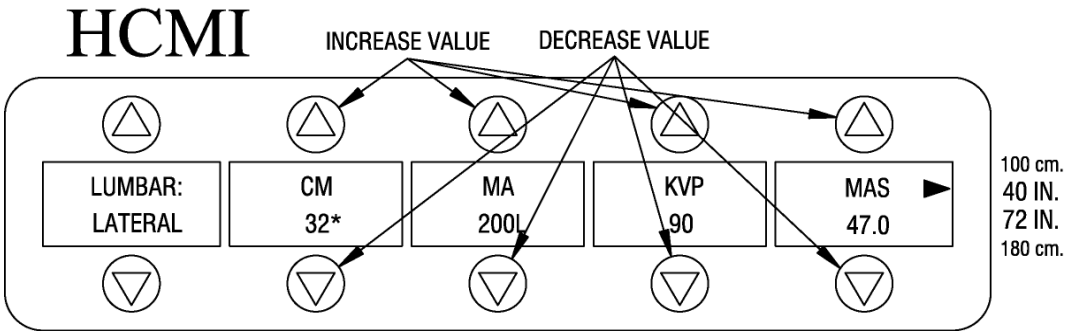


Figure 3-8 Auto-Tech Menu with Modified Techniques

Preparing To Take an X-Ray Exposure

After exposure factors have been verified as above, ensure that all other x-ray exposure precautions are met. If you have not already done so, position the patient accordingly and ensure that the patient is comfortable. Refer to Image Quality (page 3-13) for additional suggestions.

Taking Exposures

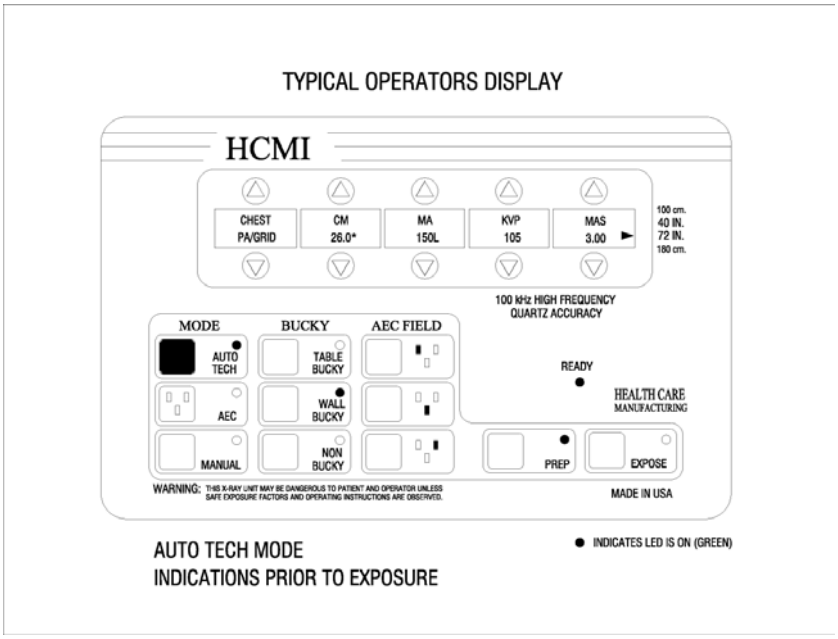
For Instantaneous Exposures:

1. Press and hold **PREP** until the **PREP** lamp is lit steady.

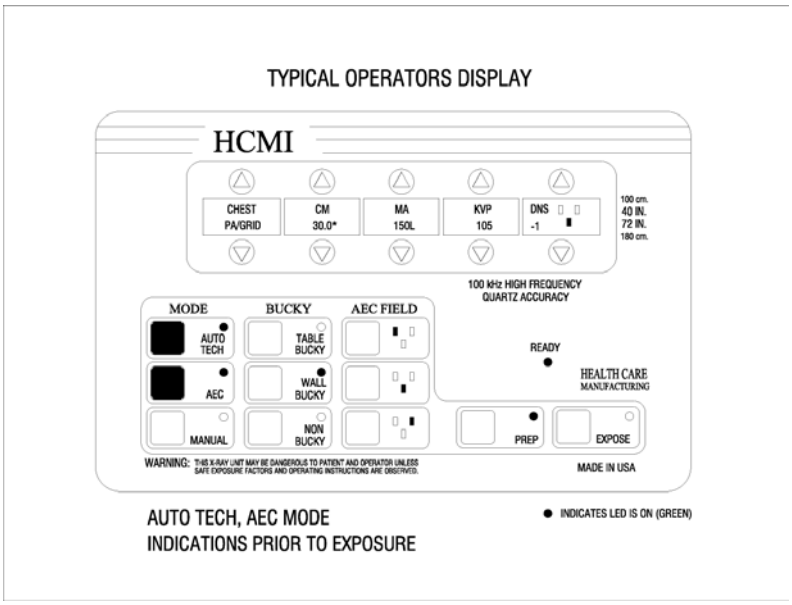
2. Press and hold **EXPOSE** until the exposure is complete (system will emit an audible tone). **Note: If you remove your finger from exposure key before the exposure is complete, the HYFOB Error will be displayed.**

Typical Operators Display Prior To Exposure

Auto Tech Mode
Figure 3-9

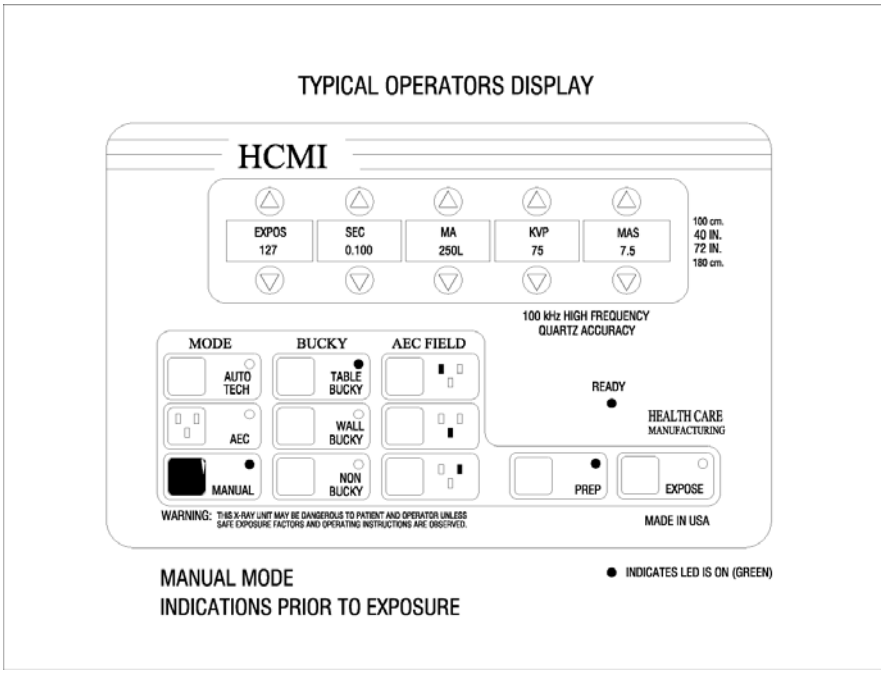


Auto Tech, AEC Mode
Figure 3-10

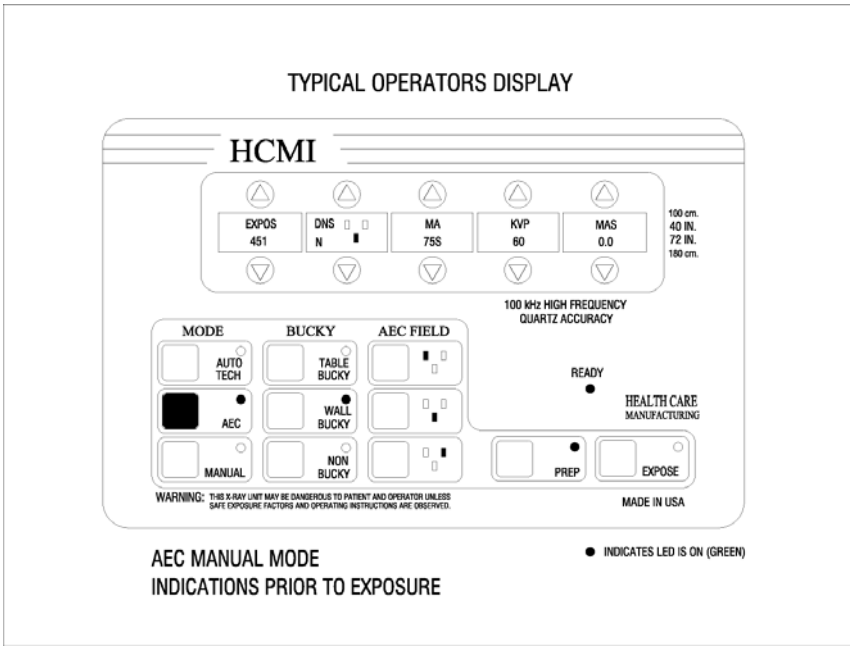


Typical Operators Display Prior To Exposure continued

Manual Mode
Figure 3-11



AEC Manual Mode
Figure 3-12



Fault Reset

When **AEC** mode is enabled, exposure time/termination is controlled via ionization chamber sensing circuits. In addition, a back-up time is pre-programmed into the system to help prevent excessive patient dose in the event of an AEC system malfunction. If the AEC exceeds the back-up time, exposure will be terminated and a fault/reset message will be displayed on the OCP display (example shown in figure 3-13). Press **RESET** to clear the fault. If the fault persists, the system may be used in manual mode until the fault can be isolated or corrected.

Figure 3-13 AEC Fault/Reset Display

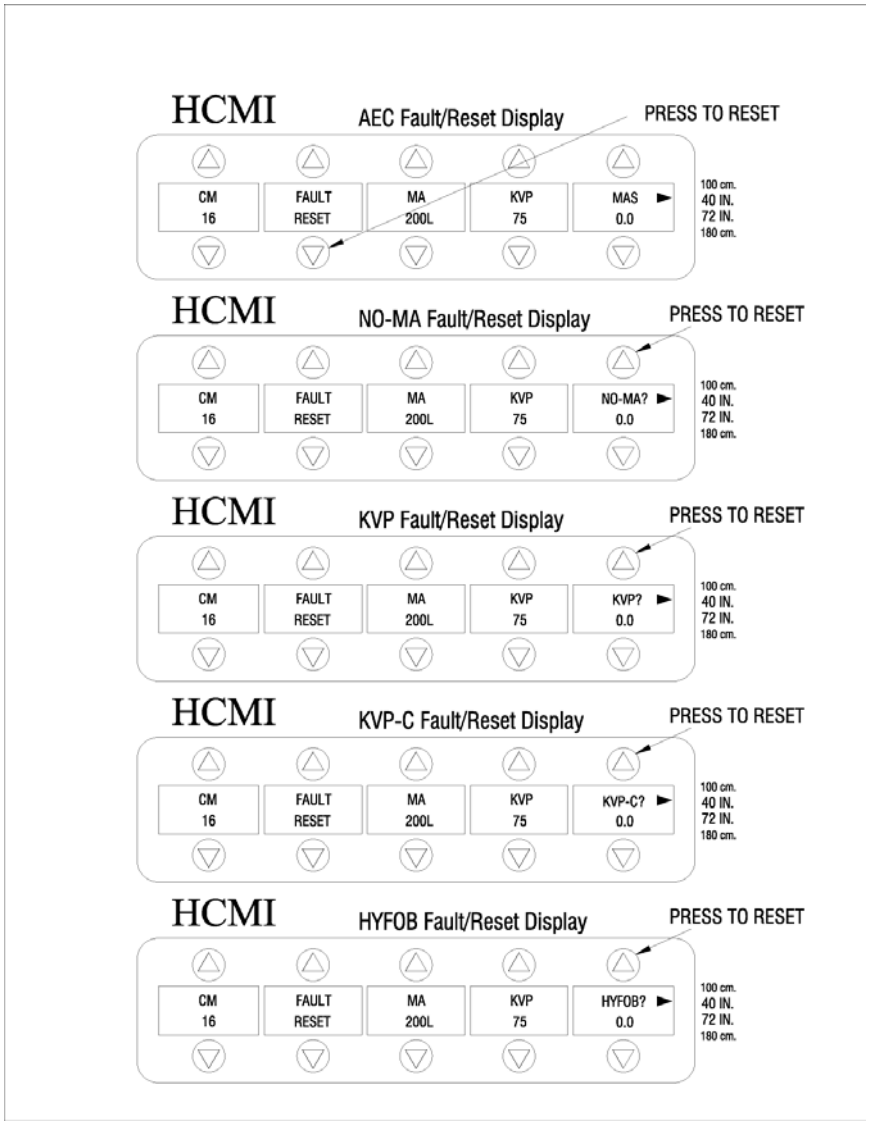


Figure 3-14
Exposure Fault Error Message.
Press **Reset** to Clear
If Error Message Continues Call For Service

Image Quality

You should always keep in mind the following basic parameters to achieve the best results in diagnostic film quality:

- **Make sure that your system is operating properly by scheduling routine quality assurance and maintenance as required.**
- **Motion artifacts can be reduced by making the patient as comfortable as possible. Always treat the patient with utmost care.**
- **Patient positioning is achieved by making sure the area of interest is on the film.**
- **Decreasing kVp value increases contrast.**
- **Increasing mAs value darkens the image.**

SECTION D

SYSTEM DIAGNOSTICS

SYSTEM DIAGNOSTICS

Overview

This section is for system users or technicians to assist in locating and correcting minor system faults, should they occur. The majority of these faults can be corrected without a service technician. System faults that require the attention of a service representative are referenced in Section H, Planned Maintenance.

Error Messages and Descriptions

When the unit will not expose, an audible alert will sound twice and one or more "error codes" will appear on the display.

Refer to the following descriptions for assistance in interpreting the fault code displayed on the Operator Control Panel:

BUCKY?	A bucky has been selected but it did not return the ready signal to start exposure or AEC is selected and no bucky has been selected.
DOOR?	The door interlock circuit is not closed.
FAULT?	Indicates that there is a problem with the AEC.
FIELD?	Control tried to take an exposure with AEC mode enabled but an AEC field was not selected.
FILAM?	Indicates there is a problem with the filament or filament control circuit.
KVP?	Indicates a problem with the anode circuit or high voltage transformer.
KVP-C?	Indicates a problem with the cathode circuit or high voltage transformer.
FAULT RESET	Indicates error during exposure**.** Requires manual reset to resume operations.
HYFOB	"Hold your finger on button". Removed finger on expose switch too soon. Short exposure.
STACK ERROR	Microprocessor de-railed and locked out. Turn power off and reset after one (1) minute. This problem will return, contact factory.

SYSTEM DIAGNOSTICS

Error Messages and Descriptions continued

NO MA?	Control tried to take an exposure, but there was no tube current during exposure time.
TUBE?	Oil pressure switch in x-ray tube open, check temperature
ROTOR?	Tube rotor is not getting correct current to start. Check rotor circuit.
BATERY?	If the **Ready** light is off, the batteries are not charged and a **BATERY?** error is displayed when the **PREP** key is pressed; leave unit on to restore voltage. (**LOW BATTERY VOLTAGE)**
OVERLOAD	Indicates that you have exceeded the maximum tube load rating. Reduce technique factors.
NO BUSS **HF 300/600 ONLY**	Indicates fault in power buss voltage. Measure voltage at IGBT Driver boards 370-385 VDC, check fuses.
WARNING **BAD Kv**	Calibration data incorrect. Re-set to default values. KV calibration required, **DO NOT USE GENERATOR.**
BACKUP?	AEC mode only, exposure stopped by backup timer, requires manual reset.
CODE BOARD ERROR	A-911 PC board problem, check connections.

SYSTEM DIAGNOSTICS

Possible Faults

Main Circuit Breaker

System circuit breaker on and OCP is dark

- Is the power line plugged into the receptacle or connected to the main circuit breaker?
- Is there power at the receptacle or the main circuit breaker?
- Is the remote **ON/OFF** switch on the OCP in the **ON** position?
- Auto Shut Off feature activated. If system was left unattended for sixty (60) minutes or more, the Automatic Shut Off feature was activated. You can reset the system by setting either main or remote **ON/OFF** switch to **OFF**, then back to **ON** position. Refer to Section C, System Operation, for additional information.
- If any of the system checks outlined above do not solve the problem, refer to Section 8, Planned Maintenance and Troubleshooting.

No Exposure

- Are any error messages displayed?
- In areas where power is known to be erratic, or if a "brownout" or power reduction has taken place, it is necessary to check your input power.

Image Quality

- Motion artifacts? Relax the patient. Make the patient as comfortable as possible. Check once again for proper positioning.
- Is there not enough contrast? Decrease kVp. Check the dark room, film expiration date, chemicals and developer temperature.
- Correct film **type** (blue or green) sensitive, must match cassette screen **type.**

SECTION E

INSTALLATION

INSTALLATION

Installation Instruction Advisory

In order to facilitate a timely installation and ensure compliance, it is recommended that the installer review this manual in its entirety and then starting from the beginning, follow **ALL** procedures in each section.

WARNING: Failure to follow the procedures in this manual may result in electrical or mechanical safety hazards and failure to meet governmental requirements.

CAUTION Hazardous voltage contact will cause electric shock or burn. Disconnect all electrical power, including remote disconnects, before servicing.

Overview

This section provides procedures for installing the HF Series generator, from pre-installation guidelines to the final system inspection prior to operation. These procedures should be reviewed carefully before beginning the actual installation.

WARNING: Installation procedures should be performed by trained, qualified personnel only!

Pre-Installation Guidelines **(Also see HCMI, Inc. Pre-Installation A-E for more detail).**

While site planning is the customer's responsibility, the following are recommended guidelines:

Verify Space/Location of Equipment

In radiology site preparation, it is essential to verify that the location and space allocated for the equipment is sufficient. Please refer to Figure 5-1 for the HF Generator dimensions; this diagram specifically references the access panels and cable openings to assist you in this effort.

The room plan should show the following for the equipment:

Pre-Installation Guidelines continued

- **All working and parked positions**
- **Overall dimensions**
- **Total equipment weights and power outputs**
- **Structural mounting and attachment methods**

Electrical Requirements

In addition to providing for the physical requirements of the equipment, it is also vital to prepare for the power requirements. Please refer to Section B, General Information, Figure 2-0, for power requirements and model dependent power specifications. This information is used to prepare the system wiring and cabling.

Installation Procedures

The installation may be divided into the following tasks:

- Installing/connecting the equipment (See Figure 5-2d).
- Powering the system
- Calibrating the system
- Verifying programmed techniques
- Inspecting the system

Unpacking/Installing/Connecting the Equipment Generator Cabinet

The HF Series generators are shipped in two crates. The large crate contains the x-ray generator cabinet; the small crate contains two high voltage tanks and the Operator Control Panel (OCP). Open the crate or carton marked “Packing List Enclosed” first. Remove the packing list and use as a guide to opening the remaining cartons. Do not dispose of the packing material until the packing list is matched with the actual parts received. Should there be a shortage or damage, notify the manufacturer immediately.

INSTALLATION

Unpacking/Installing/Connecting the Equipment continued

Note: The manufacturer is relieved of any responsibility for damage during shipment after the unit is picked up by the carrier. Examine all cartons and crates carefully at the time of delivery. If damage is apparent, have the delivery driver write a "DAMAGED SHIPMENT NOTE" on copies of the freight bill, sign it, and file the appropriated carrier claim. Should you discover concealed damage, immediately notify the transporting agent and ask for an "INSPECTION of DAMAGE". The carrier will not accept a concealed damage claim if filed after 15 days from date of receipt of merchandise.

1. Stand the unit up and place it as close to the final location as possible.
2. Remove the covers from the cabinet as necessary, to gain access to the top equipment shelf.
   Note: When installing SE units only, the connectors at A288-A-J1 and A288-C-J1 must be connected to their respective locations on the Source Charger Boards.
3. Locate the OCP and place on the side.
4. If there are any loose wires resting on the top shelf, drape them across the side of cabinet.

WARNING: When unpacking and installing the high voltage tanks, DO NOT turn them on their side. KEEP TANKS UPRIGHT AT ALL TIMES!

INSTALLATION

Unpacking/Installing/Connecting the Equipment continued

WARNING: DO NOT ATTACH BRACKETS, MOUNT EQUIPMENT OR DRILL HOLES IN THE POWER CABINET PANELS OR FRAME, DOING SO WILL VOID THE WARRANTY AND COMPLIANCE TO UL 2601-1-2

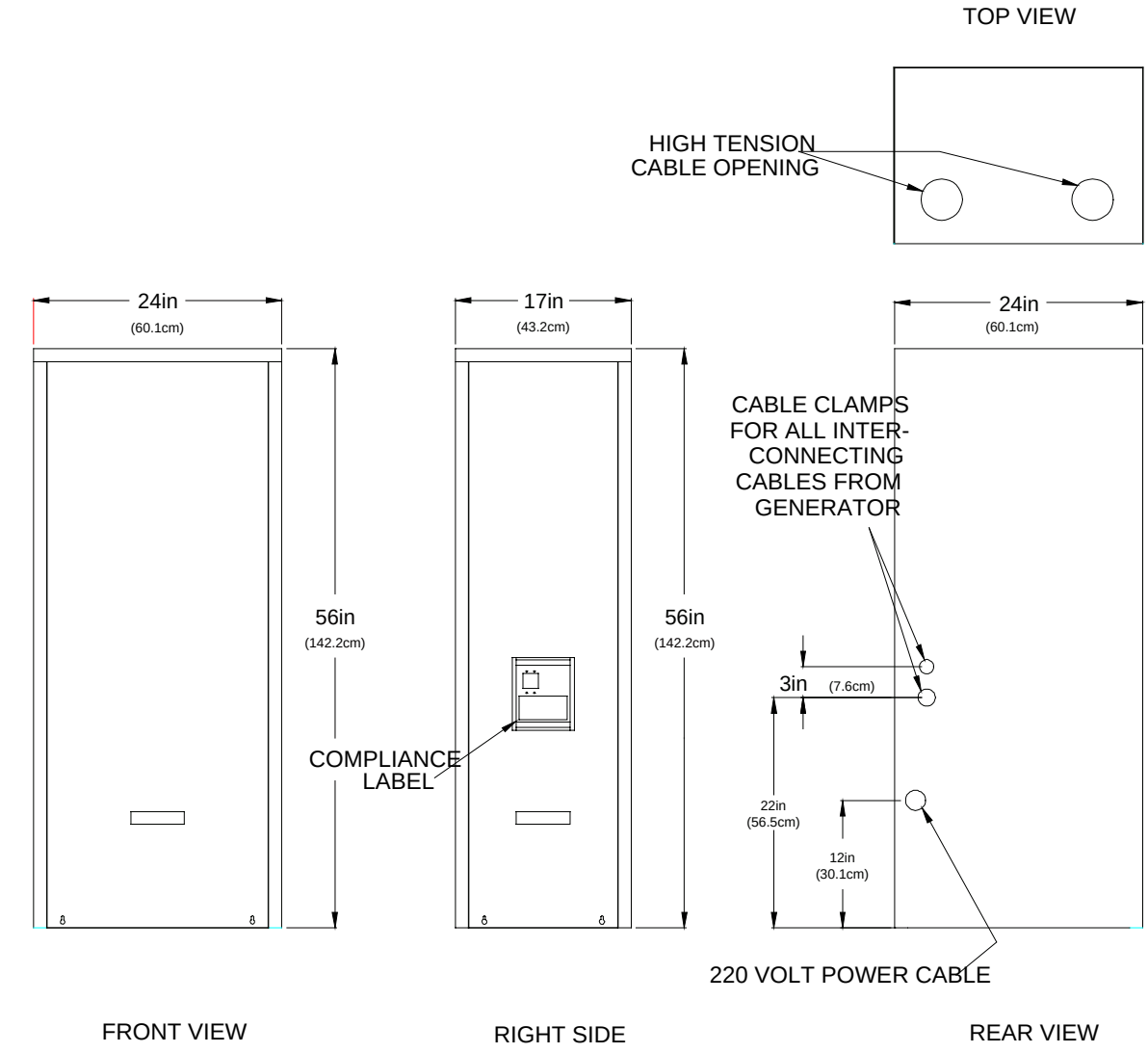


Figure 5-1 Generator Dimensions

INSTALLATION

High Voltage Tanks (Check oil level before installing, see Figure 5-1a below).

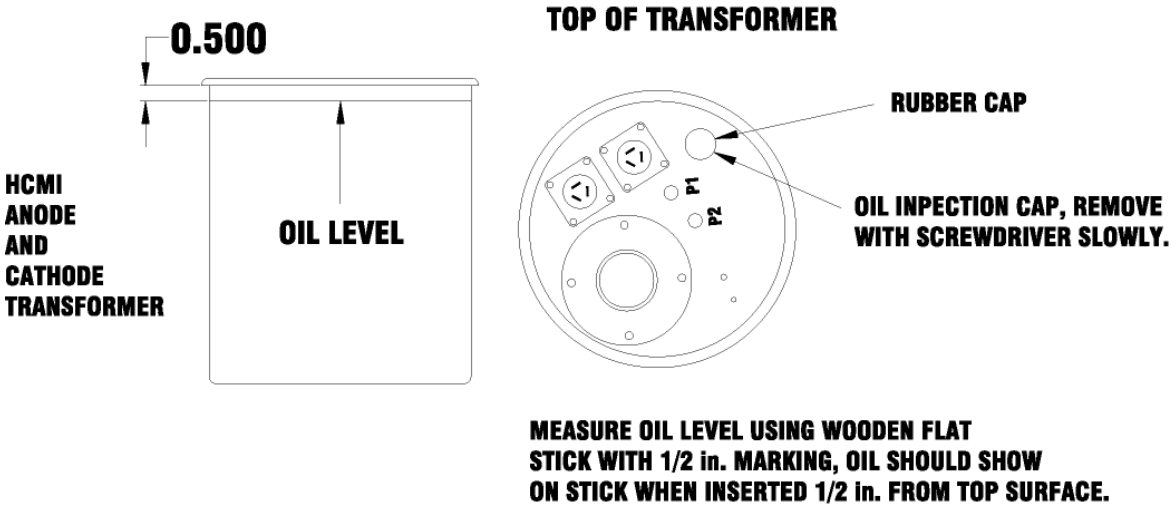


Figure 5-1a Check Oil Level

Place H.V. tanks on the top equipment shelf, inside the clamps. When facing the front of the unit, anode tank should be on right side, cathode tank on left side.

1. Locate ground wires for each tank (yellow/green, yellow/green and purple for anode; yellow/green and yellow/green for cathode) and securely fasten to ground lug (GND) on tank with 8/32 kep nut (see figure 5-2, page 7 Sec E).

INSTALLATION

High Voltage Tanks continued

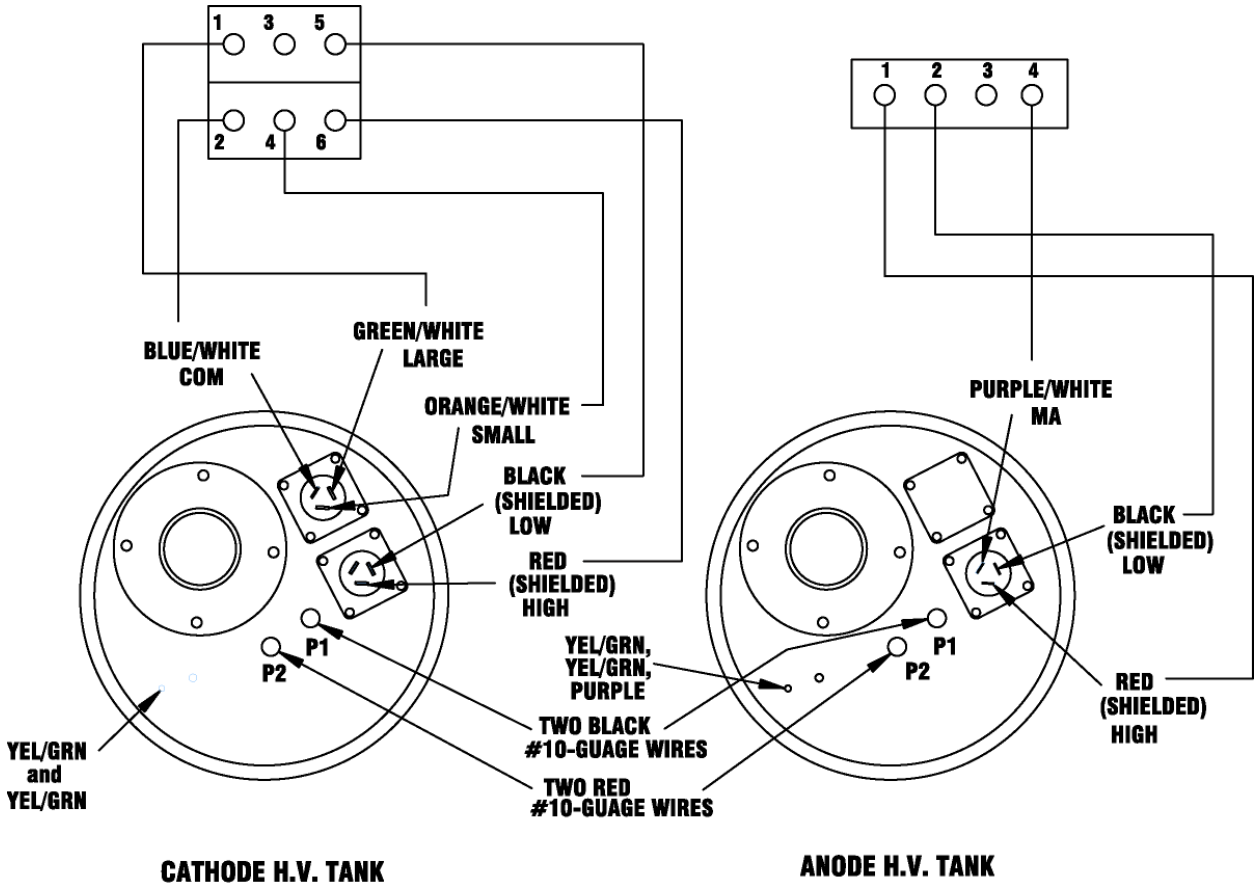


Figure 5-2 High Voltage Tank Connections

INSTALLATION

High Voltage (High Tension) Cables

It is important that these instructions be followed for the proper installation of the high voltage cable plug into the tube and high voltage tank receptacles. Please use proper handling to ensure cable terminations and receptacles are clean and free of moisture. Connect high voltage cables (anode and cathode) as follows in figure 5-2a.

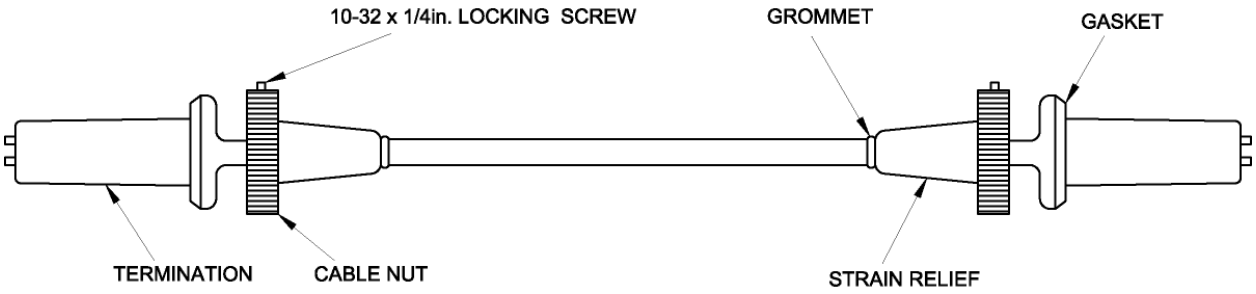


Figure 5-2a Connect High Voltage Cables

1. Assemble onto the high voltage cable end of cable retaining nut, grounding washer and strain relief if these parts are not already assembled to cable, (see figure 5-2a above). Make certain the 10-32 X 1/4" locking screw is turned out so as not to interfere with engagement.
2. High voltage cable plugs must be installed in the tube housing receptacle and the transformer receptacle respecting proper anode and cathode polarity.
3. The cable terminal plugs and tube and transformer receptacles must be clean, dry and free of any previously-used insulating compound. Be sure compression gaskets are in place on the cable plug. To insure proper locking and grounding of the cable sheath do not omit the compression gasket on the terminal plug as it is necessary for proper contact between cable nut and flare.
4. Insert the termination plug into the receptacle socket (watch the nipple on the plug to ensure correct positioning of the contact pins). Coat the entire surface of the cable terminal insulator with insulating compound (supplied with cables) using clean, dry plastic spoon or wooden stick,. Do not use fingers. Fully cover the entire surface with a heavy coat (approximately 1/16 to 1/8 “). Build a pyramid at the tip of the plug with the height of the compound even with the contact ends.

High Voltage (High Tension) Cables continued

5. With terminal key in alignment with receptacle key-way, insert the cable terminal plug into its socket until all excess compound has oozed out. Make sure the contact pins are engaged in the holes in the socket insulator and wipe off any excess compound.

6. Tighten the cable nut while holding the cable firmly in place. Re-tighten after calibration as some loosening may take place after the housing has been heated and cooled. With cable nut properly tightened, secure with 10-32 X 1/4" locking screw.

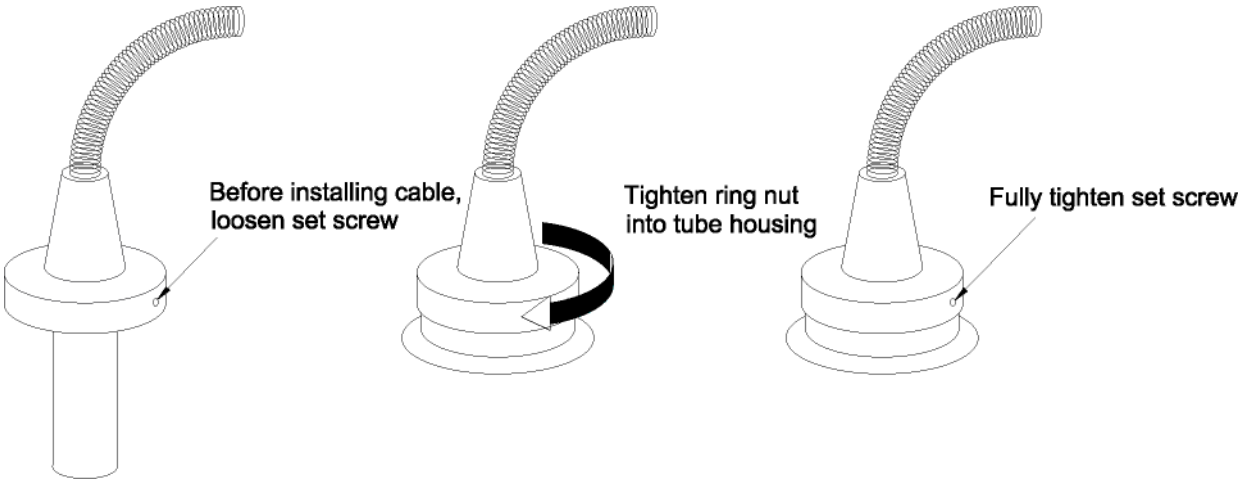


Figure 5-2 b High Tension Cable Installation

7. Place cover plates around the high voltage cables on the outside of the cabinet in order to close off large openings as shown in Figure 5-2c, page10, Sec E.

INSTALLATION

High Voltage (High Tension) Cables continued

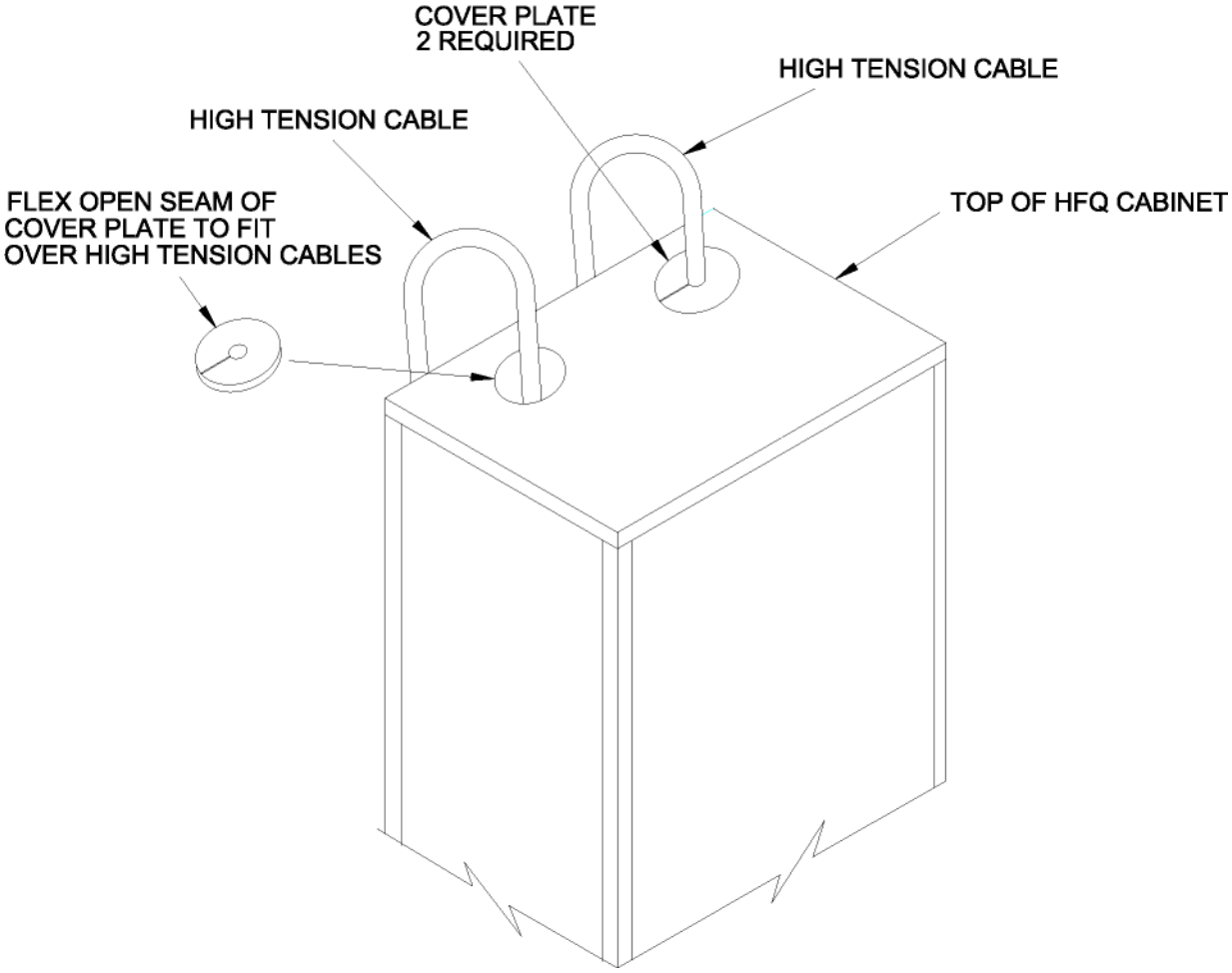


Figure 5-2c Cabinet Top Cable Assembly

INSTALLATION

Operator Control Panel

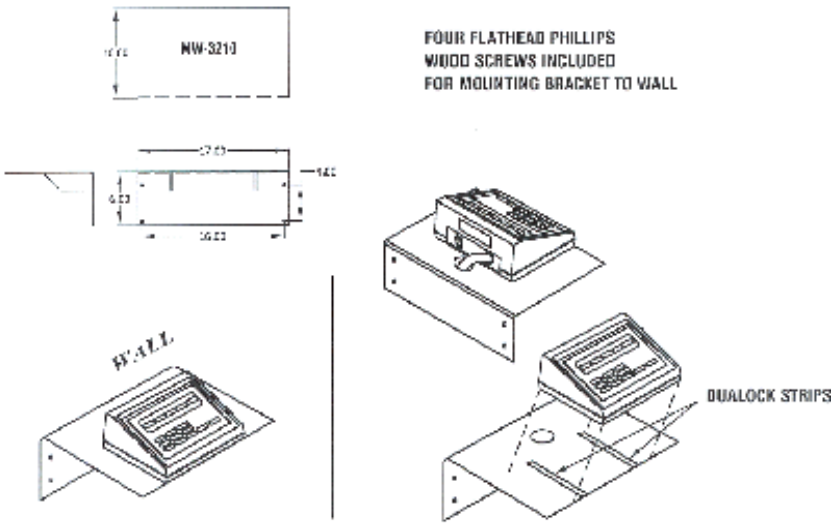
Step 1 Remove the Operator Control Panel from its shipping box and mount in the location of your choice. The OCP includes a 20 foot interconnect cable, consisting of two ribbon cables and one power cable. If additional length is required, you may order this cable per foot, CP-C, for this cable configuration**.**

Step 2 If the OCP is used with the optional pedestal (PDL) (shown Pre-Installation, pg D) or optional wall mount (HF-WM shown on page 12 Sec E), assemble and mount the OCP.

Step 3 Connect OCP interconnect cables to power cabinet through cable entrance hole separate from all power cables (rotor, collimator, locks, etc.). Do not wire tie low voltage ribbon cables to high voltage or rotor cables.
Attach one cable to A-272-J3 (microprocessor board) marked 272-J3 connect ground shield to ground. (Chassis).
Attach one cable to A-198-J2 (LCD driver board) marked 198-J2 connect ground shield to ground. (Chassis).

Step 4 Connect gray power cable (remote **ON/OFF** control) to TB1, connections 1 and 2 on the **POWER SHUT OFF** board (A-202).

Operator Control Panel continued



Operator Control Panel

Procedure for Assembly

Bucky/Collimator Interconnections

In general, bucky, table and tube housing assemblies are interconnected to the HF Series generator via the Interconnect Panel (A-Din Rail). Table 5-1 provides cable color codes and terminal connection data. Install the bucky according to the instructions provided with the bucky. Figure 5-4 is interconnection diagrams for bucky and collimator wiring.

If a reciprocating bucky is installed in the table (Bucky 1), the jumper connection on interface board A Din Rail at COM 1 and CONT, must be removed. If a reciprocating bucky is installed in the wall (Bucky 2), the jumper connection on interface board A Din Rail at COM 2 and **CONT** must be removed. Please note that all system interconnections must be secured with the strain relief clamp.

INSTALLATION

Powering the System

Power Connections

1. HF-300/600 Generators require a line disconnect box (or according to local code) before the x-ray generator. This switch should be within reach of the operator. A separate earth ground, #6 AWG insulated wire, (green with yellow stripe) must be installed. The ground wire must be the **ONLY** wire connected to the ground terminal. See Fig 5-2d for power connections L1 & L2 and ground.

   HF-3SE can be plugged into a standard switched 120 VAC grounded outlet. The outlet receptacle should be within reach of the Operators Control Panel (OCP). The HF-3SE unit is factory wired and tested at 120 VAC. Voltage ranges from 105-130 VAC, 50/60 HZ. Must be connected only. **(See NOTE A, System Schematics).**

   HF-3SEE units are 200 to 250 VAC, 50/60 HZ. **(See NOTE A, System Schematics).**

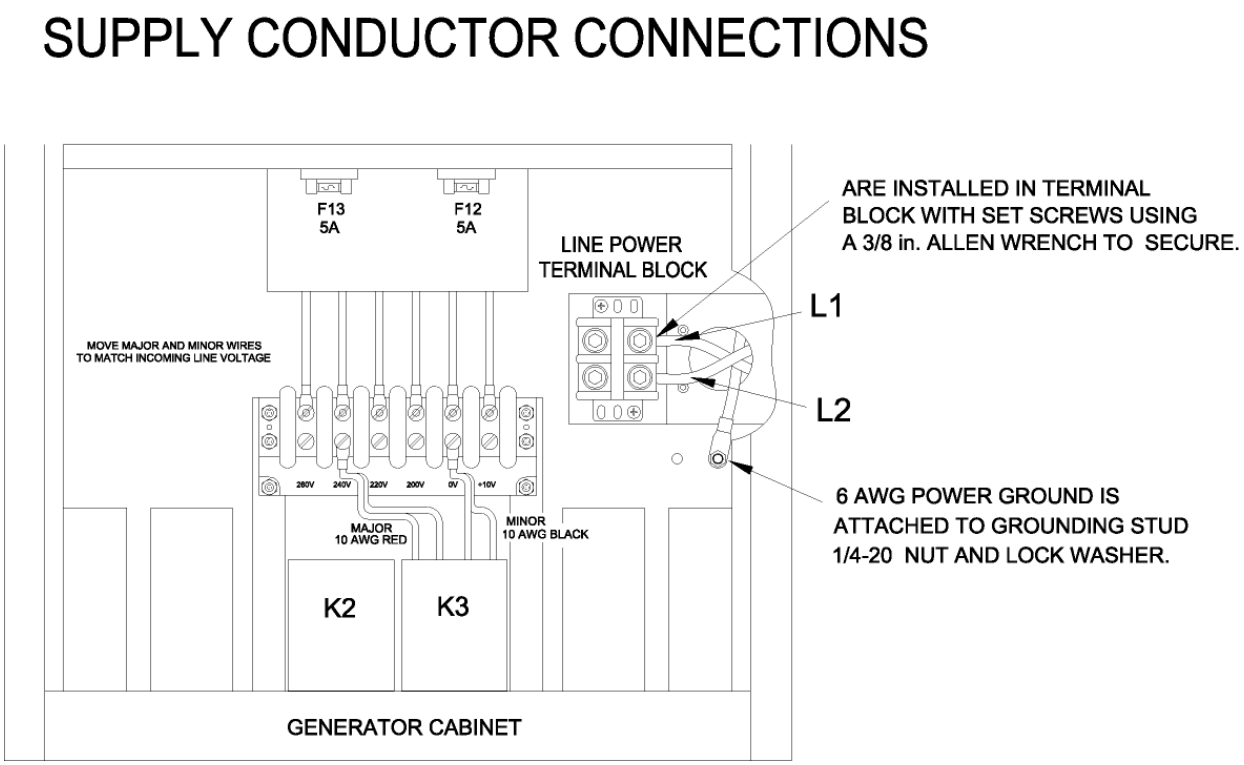


Figure 5-2d Supply Conductor Connections

INSTALLATION

Verify Input Power Procedures

1. Using a calibrated DVM, measure the input line voltage. HF-3SE version can operate between 105 and 130 VAC; HF-3SEE version scan operate between 200 and 250 VAC. **(Refer to Section B, Electrical Requirements, Figure 2-0).**
2. Adjust transformer to match the input line voltage as closely as possible. On non-SE models, the correct line location will yield 235 to 245 VAC measured between the 0 terminal and the 240V terminal.
3. For non-SE models, it is necessary to insure that the line resistance meets requirements as stated in Section B, General Information, Figure 2-0 page 6. To measure line resistance, follow the next five steps.
    1. Connect an Ohm/Stat to the incoming line and an AC voltmeter to terminals marked meter.
    2. Measure the input voltage and record the Eo number (no load voltage).
    3. Press the switch and record the Eb number (load voltage).
    4. Calculate the Line Resistance using the following formula:

        $RL = \frac{Rd\ (Eo-Eb)}{Eb}$ Example $\frac{2.75\ (220-218)}{218} = \frac{5.5}{218} = 0.025$

        RL = Line resistance
        Eo = No Load Voltage
        Eb = Load Voltage
        Rd = Load Resistance (See Ohm/Stat for Rd value)
    5. Refer to Table 2-0 for the maximum acceptable line resistance; if line resistance exceeds the specification, **contact factory**.

Calibrating the System

After installation, the system must undergo a series of electrical checks. These are required to validate system compliance. Refer to Section F, Calibration, and proceed to calibrate the HF generator.

Verifying Programmed Techniques

After the calibration procedures have been completed, check the factory programmed techniques for individual preference. Reference Section G, Programming/Utilities for procedures to edit existing techniques or write new ones if and as needed.

INSTALLATION

Inspecting the System

Please follow each step to ensure completeness of inspection.

1. Replace all cabinet covers; ensure that the cover plates are placed around the high tension cables on the outside of the generator cabinet.

2. Make sure cabinet is securely positioned. See Pre-Installation /Figure 1 Generator Cabinet, pg. B.

3. Check all controls and indicators to verify operation.

4. **Complete the required paperwork:**

    a. Assembler's Report, Federal Form FD-2579
    b. Installation Quality Assurance Checklist
    c. Installation Report

Once the system has passed all steps for this final inspection, the installation can be called complete and the system is now ready for operation.

Cable Color Codes and Terminal Connection

Table 5-1

Cable Description	Gauge	Wire Color	Connection
Rotor	**16**	**Black**	**A Din Rail/6**
Rotor	**16**	**Green**	**A Din Rail/7**
Rotor	**16**	**White**	**A Din Rail/8**
Rotor	**16**	**Yellow T5**	**A- 267 Interface BD TB1 - 3**
Rotor	**16**	**Blue T6**	**A-267 interface BD TB1 - 4**

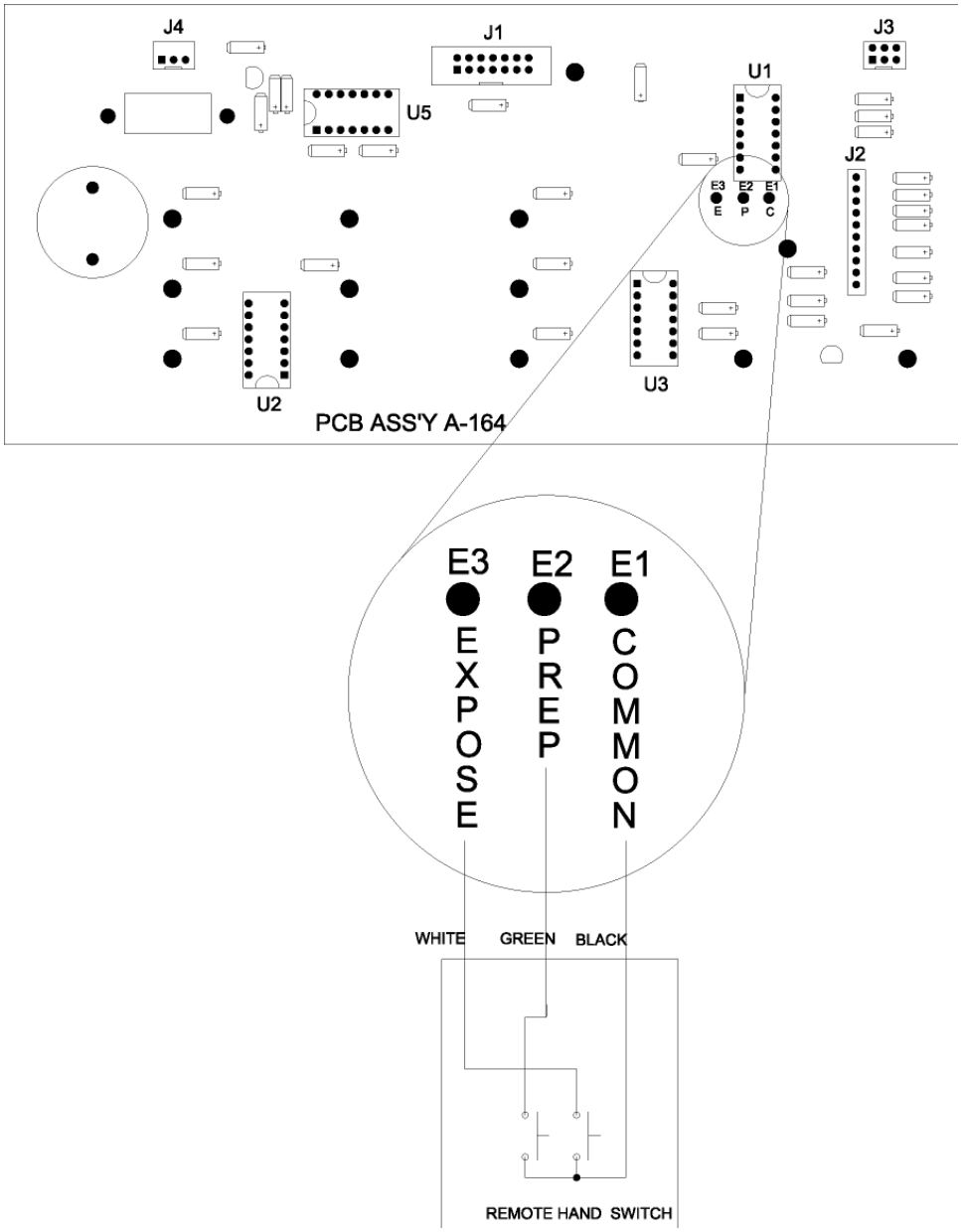


Figure 5-3 Remote Switch Connection Diagram, (OCP PC Board)

INSTALLATION

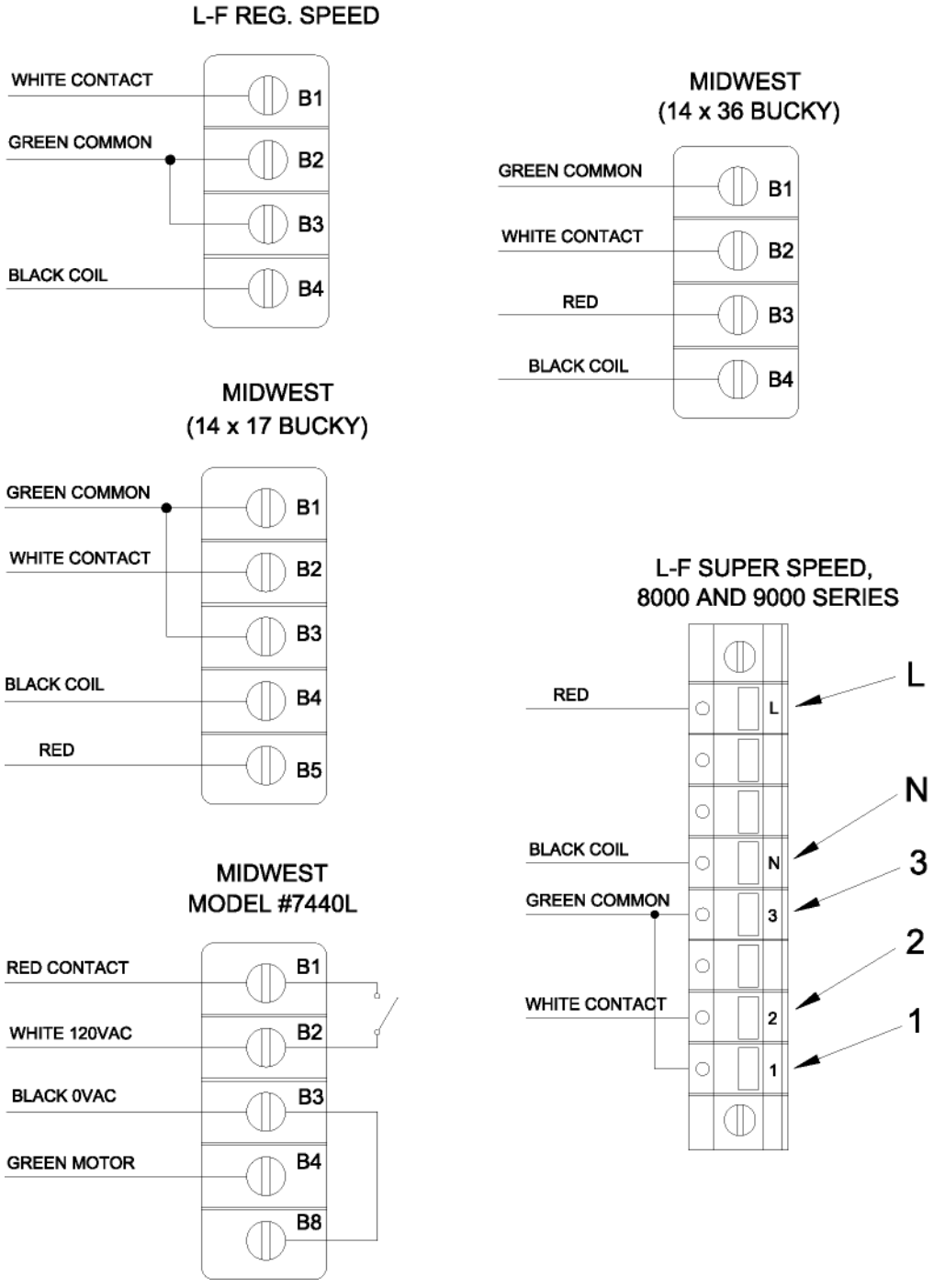


Figure 5-4 Bucky Interconnection Diagram

INSTALLATION

Line Tap Panel Used in the HF3 SE

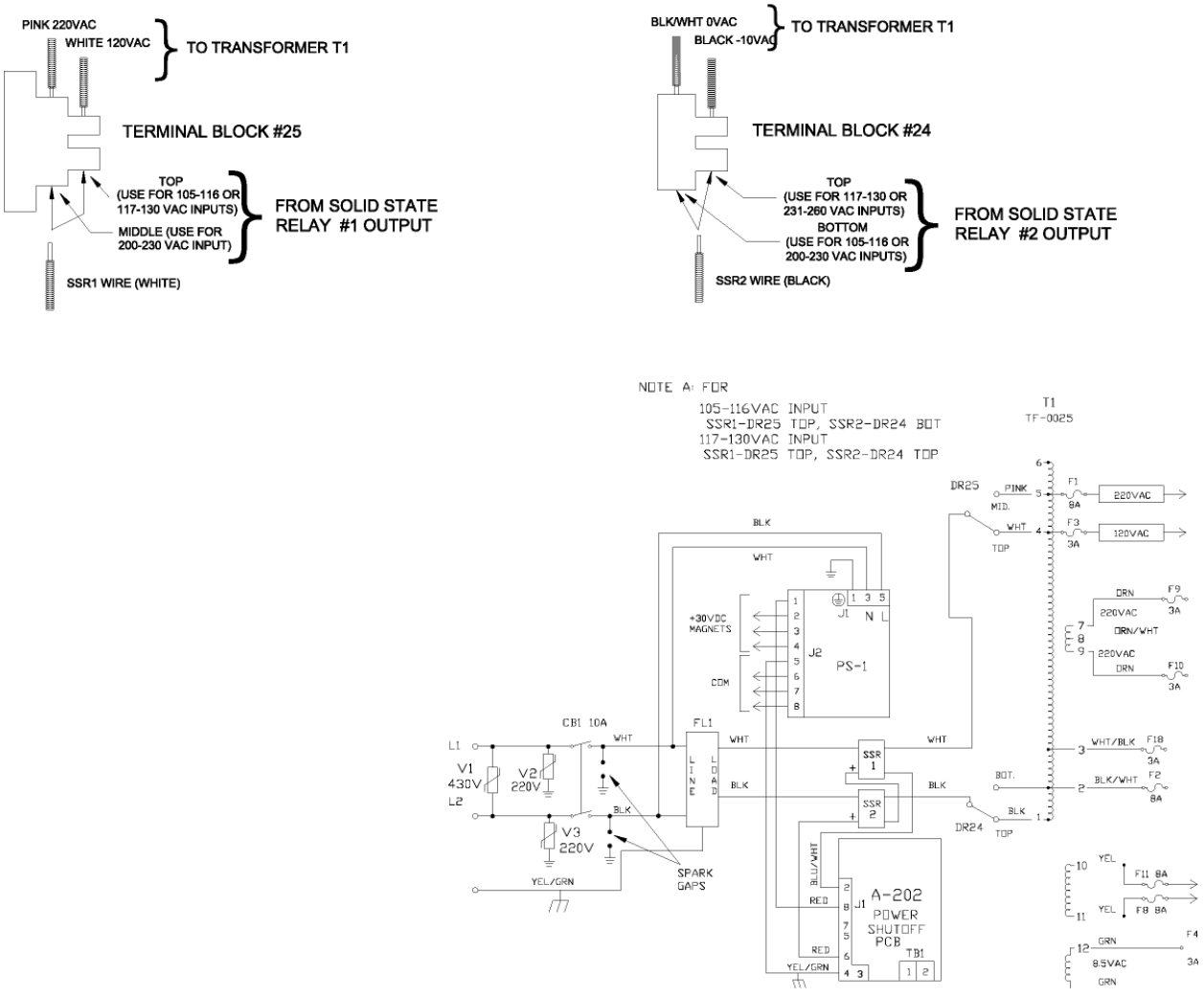


Figure 5-9 Line Tap Panel HF3 SE

INSTALLATION

Line Tap Panel Used in the HF3 SEE

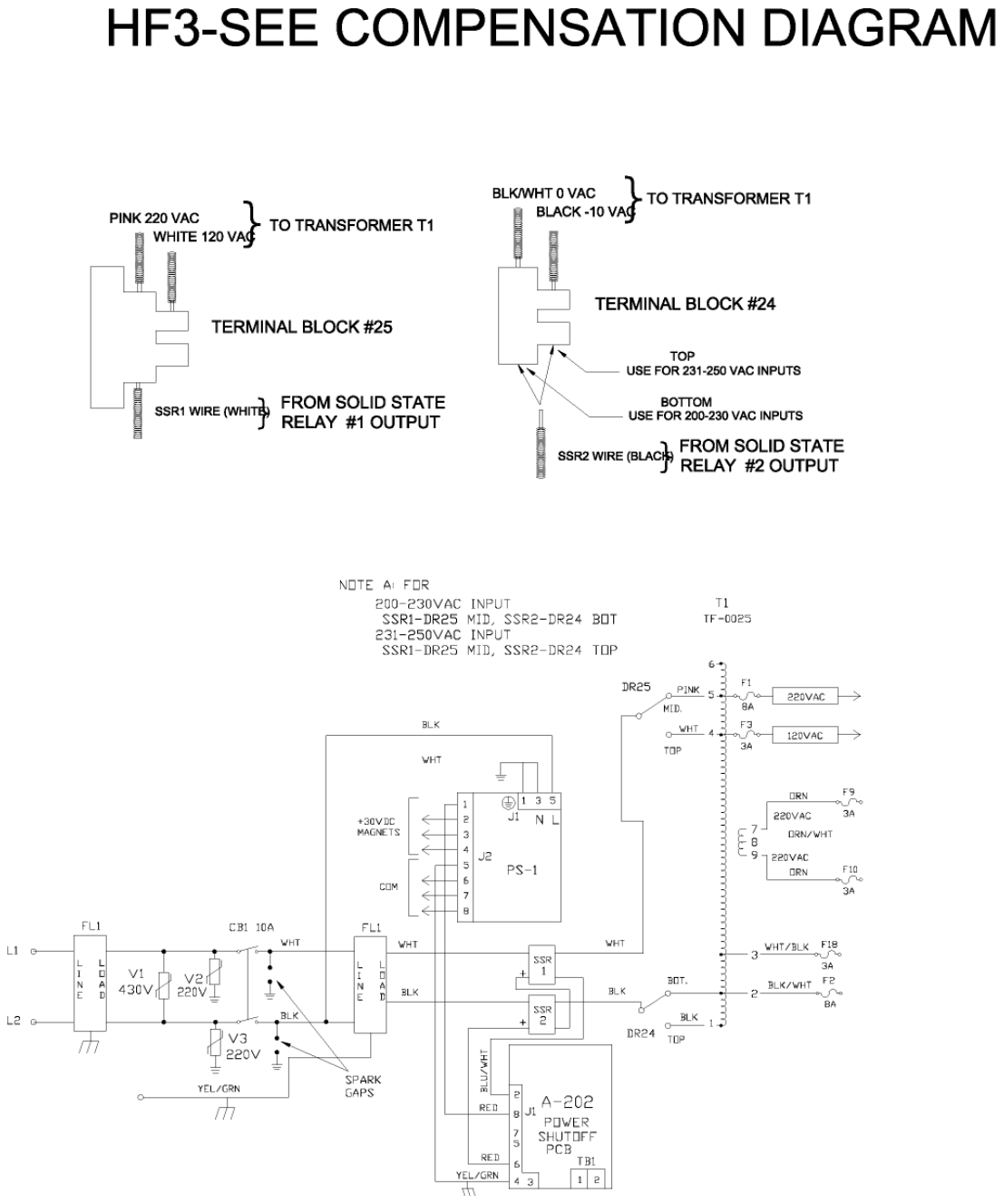


Figure 5-10 Line Tap Panel HF3 SEE

INSTALLATION

Din Rail Layout - Non SE Models

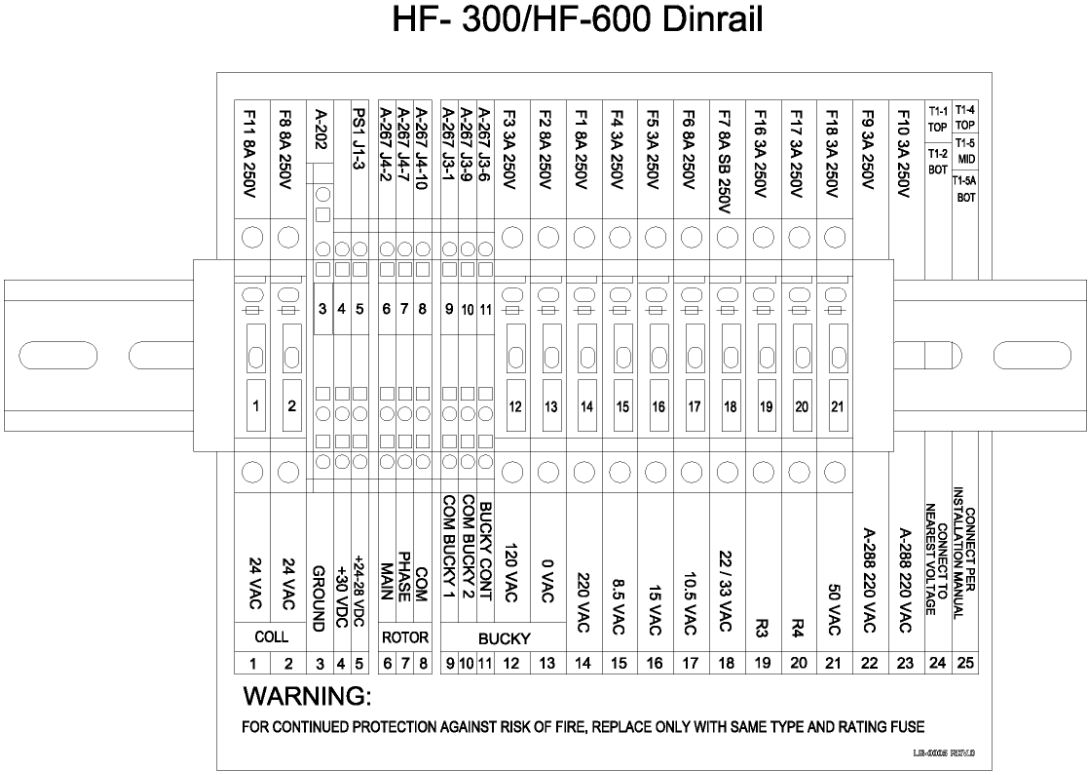


Figure 5-11 Din Rail Layout

INSTALLATION

Din Rail Layout - SE Models

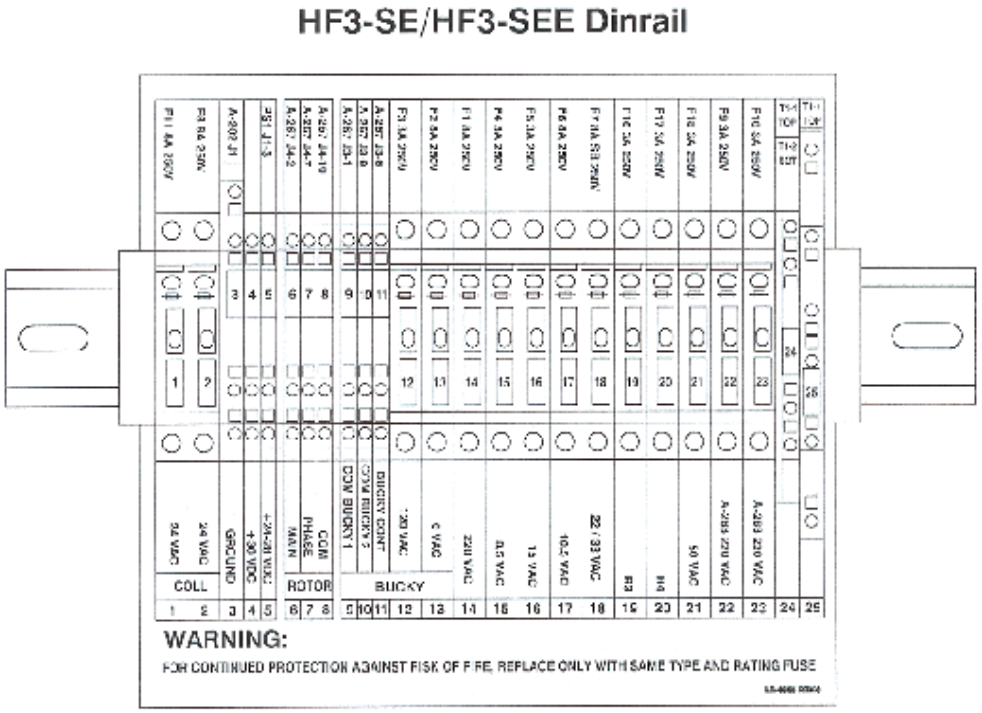


Figure 5-12 Din Rail Layout

SECTION F

CALIBRATION

CALIBRATION

Introduction

The HF generator you have purchased has been factory configured and calibrated. It is necessary, for you to perform the following electrical checks to validate the system compliance, unless otherwise instructed. For additional information, the NEMA Standards Publication /No. XR8-1979, "Test Methods for Diagnostic X-ray Machines for Use During Initial Installation" is recommended.

NOTE: Please refer to Figure 8-7 for circuit board locations.

Reference Voltage Calibration

1. Connect a DMV across TP1 of the microprocessor and ground. While monitoring the DVM, adjust R17 to -10.20 $\pm$ 0.01 V.

Liquid Crystal Display

1. To adjust the intensity of the liquid crystal display (LCD), rotate R33 either clockwise or counterclockwise on the microprocessor board.

Source Charger Calibration (A-288SES)

For SE Systems Only

Note: A fully charged system is required to set R5, R21 and R34 to proper settings.

CALIBRATION

HF-3SE/HF-3SEE

1. Connect the DVM to GND and A-288C-TP3. Adjust R5 to read between +210 and +212 VDC. D6 should be flashing.
2. Connect the DVM to GND and A-288C-TP4. Adjust R21 to read between -210 and -212 VDC. D9 should now be flashing.
3. Connect the DVM to GND and A-288A-TP3. Adjust R5 to read between +210 and +212 VDC. D6 should be flashing.
4. Connect the DVM to GND and A-288A- TP4. Adust R21 to read between -210 and -212 VDC. D9 should be flashing.
5. Turn the main circuit breaker off. Wait until D6 and D9 LED's go off and disconnect A-288C J3. Turn the main circuit breaker back on.
6. Connect the DVM to GND and A-288A- TP2. Adjust A-288A-R34 to read +4.8 volts. Turn the main circuit breaker off. Wait until A-288A&C D6 and D9 LED's go off, replace A-288C J3. Turn the main circuit breaker back on. Measure TP2 on A-288C board for 7.3 VDC, adjust R34 for correct setting.
7. Connect positive and negative leads of the DVM to A-288C TP3 and TP4. Verify that the measured voltage is 422 $\pm$ 2 VDC. Repeat DVM connections on A-288A and measure same voltage.
8. Connect positive and negative leads of the DVM to A-188 TP-3 and TP-4. Verify that the measured voltage is 422 ± 2 VDC
9. If the actual voltage measured on the DVM is equal to or within ± 2 volts of the SES voltage displayed on the OCP, press manual key to return to normal operating mode. If not, adjust A-188-R34 until the voltage on the OCP is within ± 2 volts of the measured voltage on the DVM.

Note: Steps 1 through 4

If D6 or D9 LED's are on constant, further charging is required. Monitor respective test point and adjust as necessary.

If either D6 or D9 will not illuminate regardless of voltage, verify +15 VDC and -15 VDC.

CALIBRATION

Regulated Power Supply Calibration (A-184)
+/- 15 VDC Supply

1. Connect a voltmeter between +15V TP and GND. Observed voltage should be + 15 ± 0.2 VDC.

2. If observed voltage is within specification, continue with step 3. If not, adjust the voltage as follows:
   a. Observed voltage Low - Adjust R7 clockwise until voltage is within specification.
   b. Observed voltage High - Adjust R7 counter-clockwise until voltage is within specification.
3. Connect a voltmeter between the -15V TP and GND. Observed voltage should be between -14.4 and -15.6 VDC. (No adjustment provided).

Filament Voltage Supply

1. Connect the voltmeter between TP1 and GND. Observed voltage should be: 50 VDC ± .02. For SE units, voltage should be 33 to 36 volts factory set)..
2. If observed voltage is within specification, regulated power supply calibration procedures are complete. If not, adjust the voltage as follows:
   a. Observed voltage Low - Adjust R23 on the (A-184) board clockwise until the proper voltage is reached.
   b. Observed voltage High - Wait a minute to discharge C8, then adjust R23 counter-clockwise. Continue until voltage is lower than desired and turn R23 clockwise to the proper voltage.

CALIBRATION

KVP Control Board A-189

Warning: Do not adjust voltages on these boards during routine installation electrical checks. Calibration is required only upon board or High Voltage Tank replacement.

Warning: Set and stabilize -10.20 on microprocessor BD TP1.

ANODE

1. Locate the A-189A board and connect a voltmeter between TP1 and GND.
2. Adjust R2 for -0.80 ± .005 VDC.
3. Connect a jumper between TP3 and GND. Remove voltmeter from TP1 and reconnect to TP2.
4. Adjust R5 for -0.75 VDC ± .005 at TP2.
5. Remove jumper and voltmeter.

CATHODE

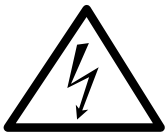
1. Before removing old cathode BD A-189C, record voltage on TP2 with TP3 grounded (ie: .650 -.790 VDC).
2. Remove power (turn-off). Install new cathode BD A-189C.
3. Connect voltmeter to TP1 and GND adjust R2 for -0.80± .005 VDC.
4. See 3 above.
5. Set R5 to recorded voltage.

CALIBRATION

Filament Control Regulator Board (A-263/A-190SE)

1. No adjustments are to be made on this board. This has been done at the factory. If any service to this board is required, notify HCMI, Inc.

WARNING: The following calibration procedures involve taking X-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are adhered to.



CAUTION: Before calibrating unit, perform seasoning procedures recommended by tube manufacturer or the seasoning procedures described in Section C, System Operation.

KV Calibration
Anode and Cathode H.V. Tank Balance Test

To calibrate kVp, a dynalyzer kVp meter (or equivalent kVp bleeder tank) is required. Please follow the next procedures:

1. If you have not already connected a kVp bleeder tank to the system, it should be connected in series between tube and H.V. tanks.

    a. Switch kVp bleeder tank to anode and take an exposure at 100 kVp, 200L mA, 20 mAs (100L mA, 10 mAs for HF-3 SE units). The kVp meter will read near 50 kVp. From the OCP, adjust kVp and repeat exposure until the kVp meter reads 50 kVp.

    b. Switch kVp bleeder tank to cathode and take an exposure without changing the OCP settings. If the kVp meter does not read 50 + /-1 kVp, adjust R5 cathode kV board and repeat exposure until the kVp meter reads 50 + /-1 kVp**.**

Warning: To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

CALIBRATION

KV Calibration continued

2. Access **kV CALIBRATION** mode as follows:

Note: If power to the system has been off, set main power switch to ON.

a. To access the Utility/Maintenance Menu (Calibration Mode):

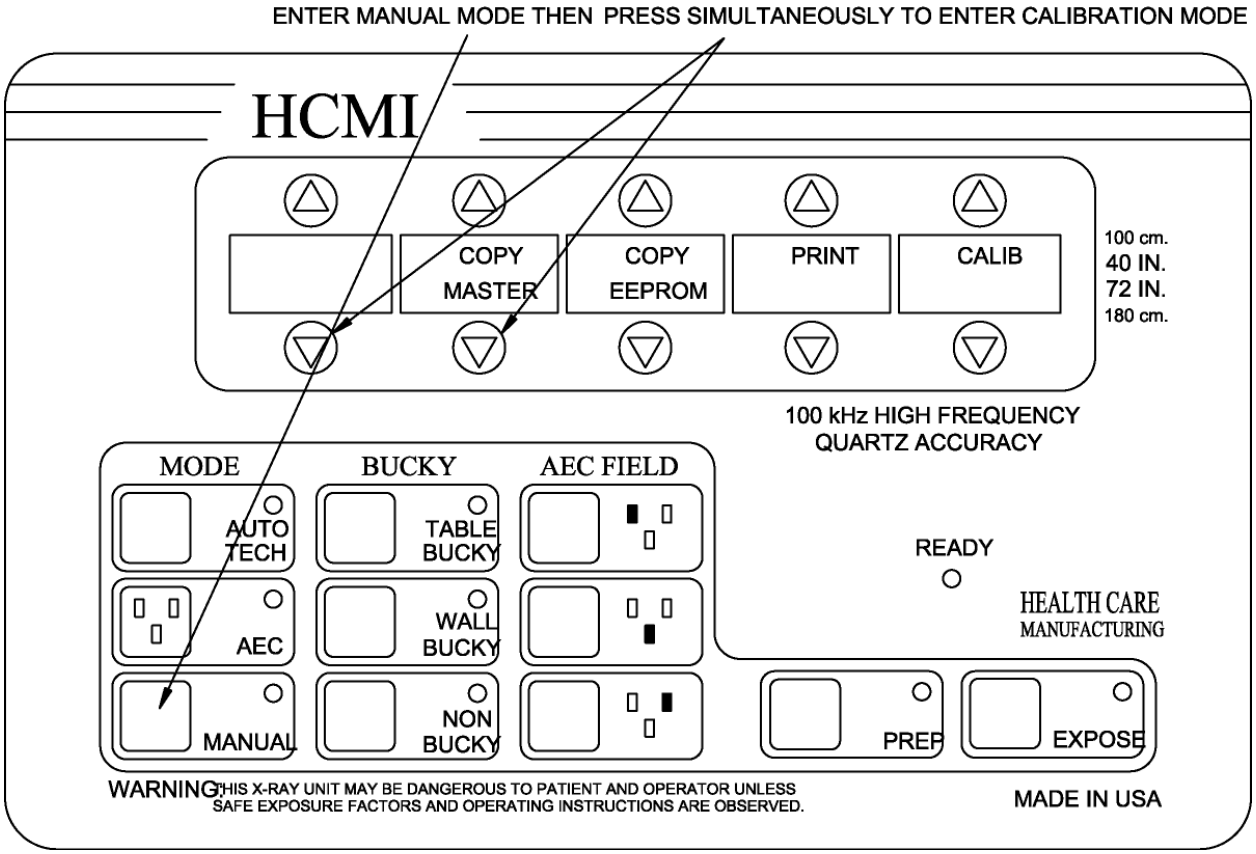


Figure 6-11 Utility/Maintenance Menu (Calibration Mode)

b. Press **MANUAL** key first to enter manual mode then press down arrows simultaneously under exposure counter and seconds. (Figure 6-11)

KV Calibration continued

c. Press **CAL kVp.**

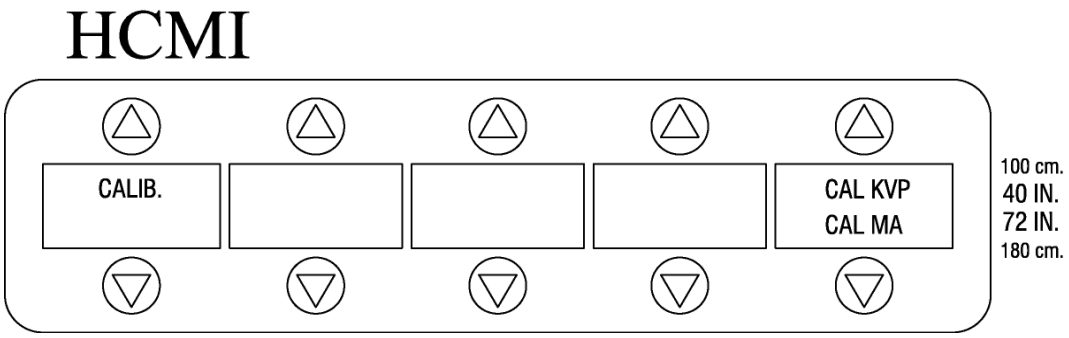


Figure 6-12 The kVp Calibration Menu will be displayed

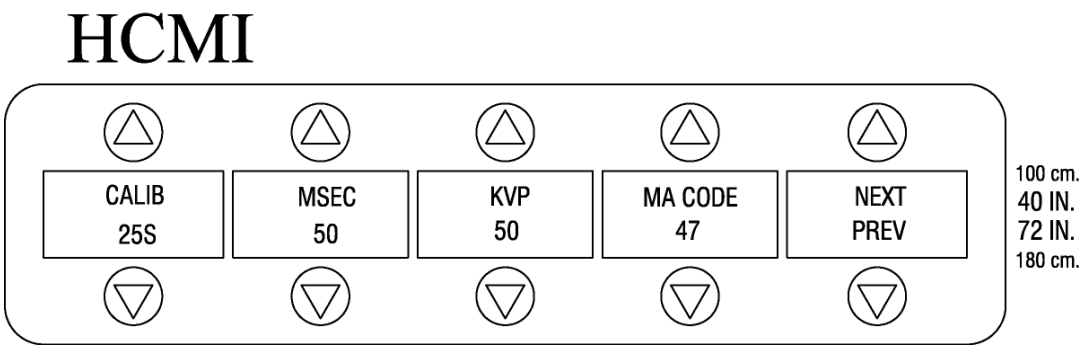


Figure 6-13 kV Calibration Menu

3. Take an exposure and verify that the kVp meter display indicates a kVp value identical to the value selected.

4. If measured kVp is correct, continue with Step 6. If not, press **KV MEAS** up or down buttons until the KV MEAS value corresponds with the actual kVp output displayed on the kVp meter.

5. Press **NEXT**. The LCD display will change to calibrate at the next kVp setting with the same mA and time.

6. Take another exposure and verify that the kVp meter display indicates a kVp value identical to the value selected.

7. If measured kVp is correct, continue with Step 9. If not, press **KV MEAS** up or down buttons until the **KV MEAS** value corresponds with the actual kVp output displayed on the kVp meter.

CALIBRATION

KV Calibration continued

8. Press **NEXT**. The microprocessor will calculate and display the slope and offset and store these numbers in memory. The LCD will display the kVp/mA Calibration Select Menu.

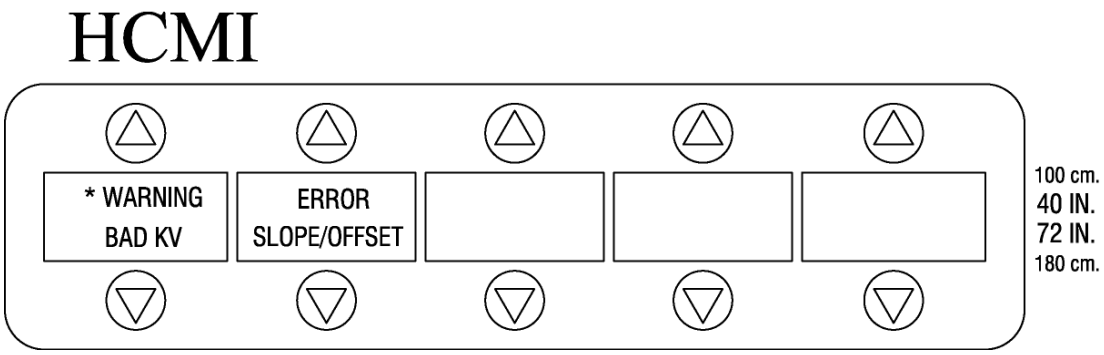


Figure 6-13a

9. Verify kV Calibration settings. Take several exposures out of calibration mode (60-70-90 kV etc).

CALIBRATION

mA Calibration

Warning: The following calibration procedures involve taking X-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are followed.

Caution: Excessive anode heat will effect mA Calibration accuracy.

1. To measure mA, use either a dynalyzer or Philips PM 2618 mAs meter or equivalent.

    a. If you are using a dynalyzer, it should be connected in series between the tube and anode H.V. tank. **The cathode tank should be directly connected to the X-ray tube**. The dynalyzer should be set for kVp trigger at 90%. In this set-up, kVp will read ½ of actual, but mA will be most accurate.

    b. If an mAs meter is used, disconnect the mA lead (purple/white) from the mA terminal on the anode H.V. tank. Connect the mAs meter in series between the mA terminal and the mA lead (purple/white) on the anode H.V. tank. This measurement may not be as accurate as when using the dynalyzer for times of 50 msec and below.

    c. When calibration is complete, disconnect the mAs meter and reconnect the mA lead (purple/white) to the anode H.V. tank mA terminal.

2. Access mA calibration mode as follows: (See figure 6-11)

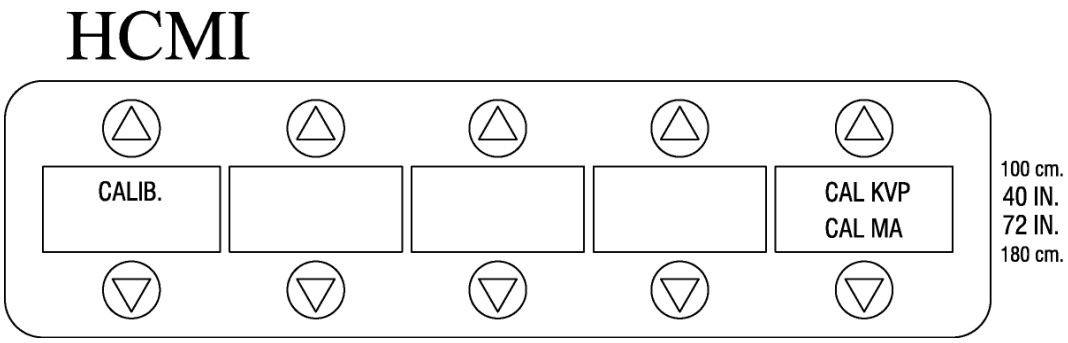
    a. Press **CAL MA** directly from the kVp/mA Calibration Select Menu.

    b. Or, if power to the system has been off, set main power switch to **ON.** To access the Utility/Maintenance Menu, see Figure A, page 3 Sec. F.

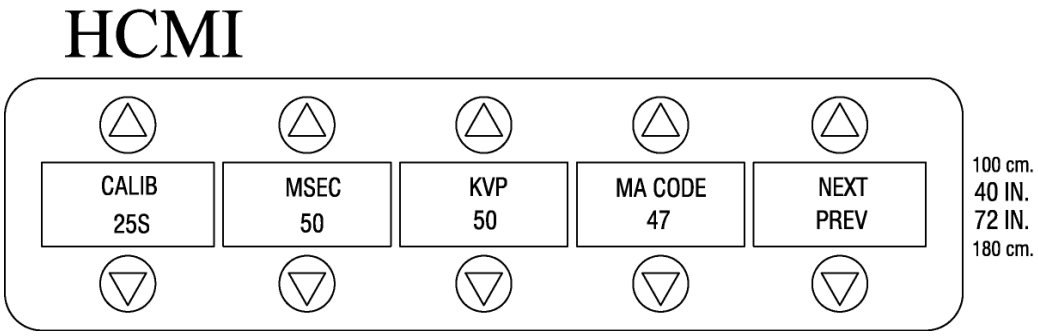
CALIBRATION

mA Calibration continued

Press **CALIB** to access the kVp/mA Calibration Select Menu.99



- **Press CAL mA. The LCD displays the mA Calibration Menu**
- **Press mA station arrow key to select mA.**



mA Station CAL-Select Press arrow UP or Down

Figure 6-14 mA Calibration Menu

Note: kVp and mA have been PRE-SET; the displayed values are model dependent.

3. Take an exposure and verify that the mA meter display indicates an mA value (see Specification Overview, Section B or page 11, Section F.) to the value displayed under **CALIB** (**25S** as shown above in Figure 6-14).

CALIBRATION

mA Calibration continued

4. If measured mA is within specification (as indicated in Section 2, General Information), continue with Step 5. If not, adjust the mA code up or down (by pressing the corresponding buttons on the LCD) to increase or decrease the mA code reading.

Note: If the specified mA cannot be obtained using the available mA code range (0-255 mA), the resistance on Filament Resistor Board A186 must be increased (when 0 is reached) or decreased (when 255 is reached) as required. This may occur, for example, when the high tension cable length or the tube is changed. After changing resistance, repeat Step 4.

5. Repeat Steps 3 and 4 until the mAs meter reading and displayed mA value are within specification. When the measured and displayed values are within specification, press **NEXT** to calibrate at the next kVp steps.

6. Repeat the calibration procedure (steps 3 thru 5) for each mA station and using each kVp step. Each mA station requires calibration at each of the six (6) pre-set kVp/time steps.

Note: When NEXT is pressed at the end of each mA station setting, the LCD momentarily displays a "Saving mA Code" message. During this time, the microprocessor is entering the calibration data. *Caution*: DO NOT OVERHEAT X-RAY TUBE: ALL SIX BREAK POINTS MUST BE ENTERED TO CALIBRATE mA.

7. After completion of all mA stations, set main power switch to **OFF** and reconnect the system.

Maximum Deviation kVp, Time, mA, mAs

1. Set the dynalyzer for mA (90% trigger level on kVp).

2. Refer to the data sheet in Section 8, Planned Maintenance and Troubleshooting, and take exposures at the required settings.

3. Run a print-out and record on the data sheet.

4. Make sure that the following are within tolerance:

   a. mA- $\pm$ 10% or 5mA, whichever is greater.
   b. kVp - $\pm$ 5%
   c. Timing - $\pm$ 1% + 3 milliseconds. Time is measured at the 90% level of the peak kV.
   d. mAs - $\pm$ 12% for time greater than or equal to 100 milliseconds and current greater than or equal to 50 mA; otherwise, accuracy is a product of time and mA accuracies.

CALIBRATION

Linearity Test

1. Take ten (10) exposures with the exposure factors from the appropriate data sheet in Section H, Planned Maintenance. Ensure that the dynalyzer or radiation monitor is set for mR, run a printout and record as Test # 1.

2. Take ten (10 exposures with the exposure factors from the appropriate data sheet in Section H. Ensure that the dynalyzer or radiation monitor is set for mR, run a printout and record as Test #2.

3. Using the data from Tests #1 and #2, refer to the Linearity Data Sheet (Section H) and calculate the Average Exposure Ratio. It must be equal to or less than 0.1.

Reproducibility

1. Take ten (10) exposures using the settings indicated on the data sheet in Section H, Planned Maintenance. Ensure that the dynalyzer or radiation monitor is set for mR, run a printout and record as Test # 3.

2. After the tenth exposure, select coef. On dynalyzer, mR reading must be less that or equal to 0.05. If a Dynalyzer III is not used, calculate the C.O.V. (Coefficient of variation) according to NEMA Standards Publication XR8, part 2, page 11, par. D.

3. Record on data sheet.

AEC Calibration (Sets Normal to 1.2 Optical Density Nominal)

***Note:* HCMI, Inc. factory adjust all AEC systems using a similar Ion Chamber. Do not adjust the ION Chamber Gain Pot until the following test settings are verified.**

The following procedures are for the purposes of using a table bucky. Make appropriate adjustments and modifications if using a wall bucky.

Before proceeding, turn the system **OFF** and then **ON** to initialize the settings. Do not press **PREP** or **EXPOSE**. Select the AEC mode.

1. Position ionization sensor under beam at 40 inches from the focal spot.

2. Press **"Auto-Tech Mode"** and select **lumbar lateral view**, **wall** or **table bucky** and **AEC Mode**, (select center field on Ion Chamber**).**

AEC Calibration continued

3. Set mA to 75S and 60 kVp. **(Note: Back-up mAs is factory set at 540 mAs)**.

4. Attach + voltmeter lead to A-194 TP2 and verify voltage reads 0 VDC, adjust R33 (kV offset) if necessary.

5. Attach + voltmeter lead to A-194 TP3 and common test point, press and release **"PREP"** button on OCP and verify 1.16 VDC at 60 kVp is present, adjust R32 (kV ref. gain) if necessary.

6. Cover AEC fields of Ion chamber with plastic container of 15 cm (6") water.

7. Set mA to 75S and 60 kVp. Take exposure. mAs reading should be 38 - 40. To increase mAs, turn R56 clockwise. To decrease mAs, turn R56 counterclockwise.

8. If proper mAs cannot be obtained @ 75S/60kVp by adjusting R56, turn R12 counterclockwise.

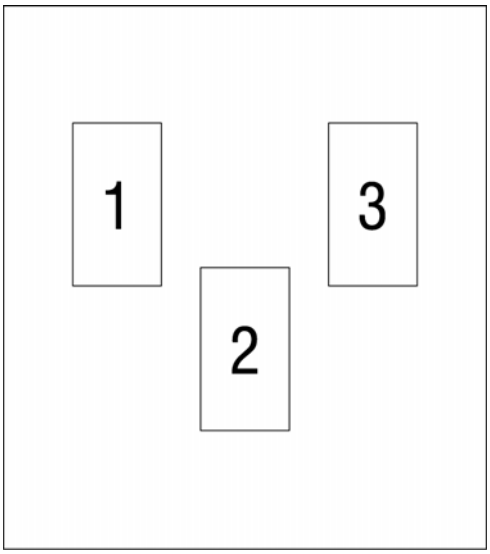


Figure 6-15 Field Locations

9. Set mA to 150L and kVp to 80. Take exposure. Mas reading should be 7.7 - 8.0. To increase mAs, turn R55 clockwise. To decrease mAs, turn R55 counterclockwise.

AEC Calibration continued

10. If proper mAs cannot be obtained @ 150L/80kVp by adjusting R55, turn R12 clockwise.

11. When proper mAs levels are set at these two (2) stations, check 150L @ 100 kVp. Mas should read approximately 3.6. Check 150L @ 120 kVp, mAs should read approximately 2.0.

12. To increase optical density of film at kVp setting 73 or below, turn R56 clockwise. To increase optical density of film at kVp setting of 74 and above, turn R55 clockwise**.**

AEC Calibration, Expose Film and Measure Optical Density

The following procedure requires film processing and measuring optical density with a densitometer.

1. Test film processor for optimum film development.
   - ♦ Check developer temperature specifications.
   - ♦ Check developer quality and specific gravity.
   - ♦ Check film processor replenish rates.

2. Test film for base fog (should be less than .19 OD).

3. Test and verify film and cassette screens for correct match and speed (400 blue, 400 green, etc.).

4. Test darkroom safe-light. Process film exposed only to safe-light and measure optical density.

Place a plastic container with 8-10 ”(inches) of water in the x-ray beam, load a film cassette and place in cassette tray. Measure optical density at 65 kVp and 105 kVp. ***** The two (2) films should not vary in optical density by more that .1.

*****The optical density of the first film is equal to the exposure mAs. Record the exposure mAs after the exposure, displayed in the mAs screen window. Measure optical density and calculate “target mAs” = (desired density divided by measured density) x elapsed mAs. Example: The elapsed mAs is 20 mAs and the density is 1.0 OD. Desired is 1.20 “target mAs” = (1.20 ÷ 1.0) x 20 = 24. The new mAs to achieve 1.20 OD will be 24 mAs.

AEC Calibration, Expose Film and Measure Optical Density continued

Two (2) Ion chambers installations should not vary by more than .12 OD wall to table.

Chamber gain adjustment: If a second chamber is used, it might be necessary to adjust the gain of the second chamber to match the one adjusted and calibrated to 1.2 optical density. Adjust the pre-amp pot marked chamber gain, take an exposure and measure optical density. Match within .12 optical density.

Auto-tech AEC can be programmed for each view, in addition to bucky selection wall or table, see Programming Utilities, Section G.

AEC Linearity Test

1. Take ten (10) exposures in the AEC mode using the exposure factors from the data sheet for Test 1. Be sure that the dynalyzer or radiation monitor is set for mR. Run a printout and record as Test 1.

2. Take ten (10) exposures in the AEC mode using the settings for Test 2. Be sure that the dynalyzer or radiation monitor is set for mR. Run a printout and record as Test 2.

3. Using data from Tests 1 and 2, calculate the average exposure ratio. Results must be equal to or less than 0.1.

AEC Reproducibility

- Take ten (10) exposures using the settings for Test 3 on the data sheet.

- After the tenth exposure, select coef. on the dynalyzer. The mR reading must be less than or equal to 0.05. If a Dynalyzer III is not used, calculate the C.O.V. (Coefficient of variation) according to NEMA Standards Publication No. XR8, part 2, page 11, par.D.

- Record on the data sheet.

CALIBRATION

Disabling Generator Exposure Audible Tone

In certain installations it may be desirable to disable the **EXPOSURE** tone that is generated at the generator electronics cabinet (located near the patient). Note that the following procedure will only disable the audible tone at the generator electronics cabinet. An audible tone will still be heard at the Operator Control Panel (OCP). Please proceed as follows to preform this task.

1. To disable the **"Exposure On"** audible tone within the generator cabinet (power unit), cut either lead of resistor R54, which is mounted on microprocessor board A-172.

SECTION G

PROGRAMMING/UTILITIES

PROGRAMMING UTILITIES

Auto-Tech Technique Programming

The following procedures provides step-by-step instructions for editing an existing technique or writing a new one and adding it to the Auto-Tech memory. Auto-Tech has the capability of recalling up to 72 anatomical views by storing up to 9 techniques in each of the 8 anatomical regions. Any of the existing x-ray techniques can be edited to suit the individual needs of your practice.

For the purpose of this description, the LCD display is divided into 10 sectors as shown in Figure 7-1, below. Each sector is controlled by the corresponding sector key located above or below that sector.

Auto-Tech Programming Procedures

1. Press **AUTO-TECH** to select Auto-Tech mode.
2. Select the region of interest (ROI) where the technique is (to be) stored by pressing the corresponding sector key. For example, to edit the LUMBAR region in the main menu (see Figure 7-1), press sector key 5.

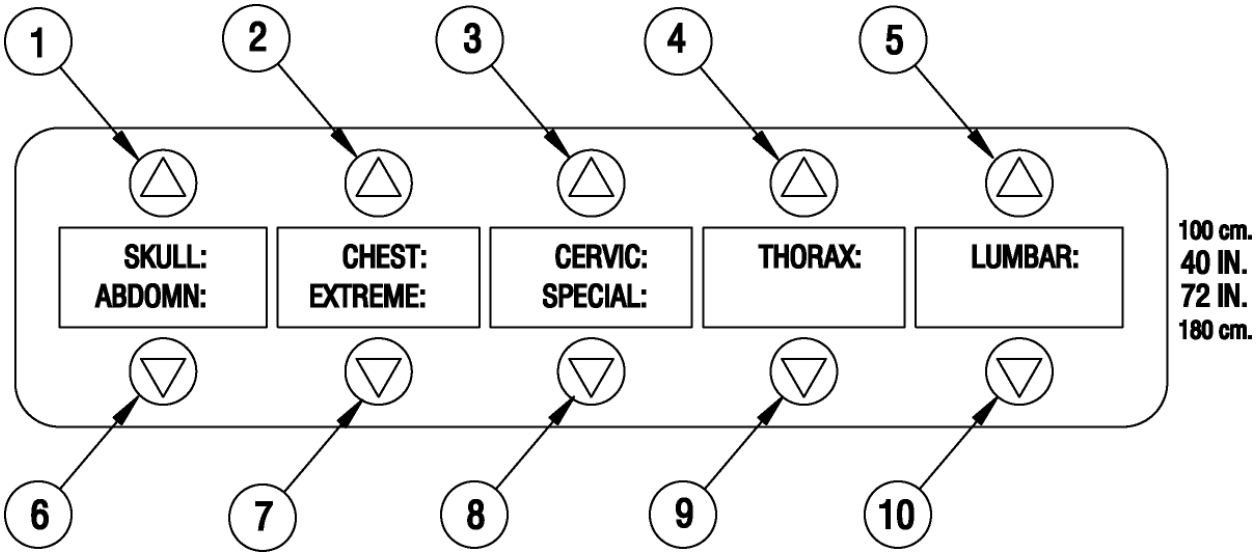


Figure 7-1 Auto-Tech Region of Interest Menu

Auto-Tech Programming Procedures (Continued)

3. Select the anatomical view for the particular region where the technique is located by pressing the associated sector key. To add a new anatomical view, (if a blank sector is available) press a blank sector key. For example, see Figure 7-2. To edit **LATERAL**, press sector key 7. To add anew anatomical view to the blank sector, press sector key 5.

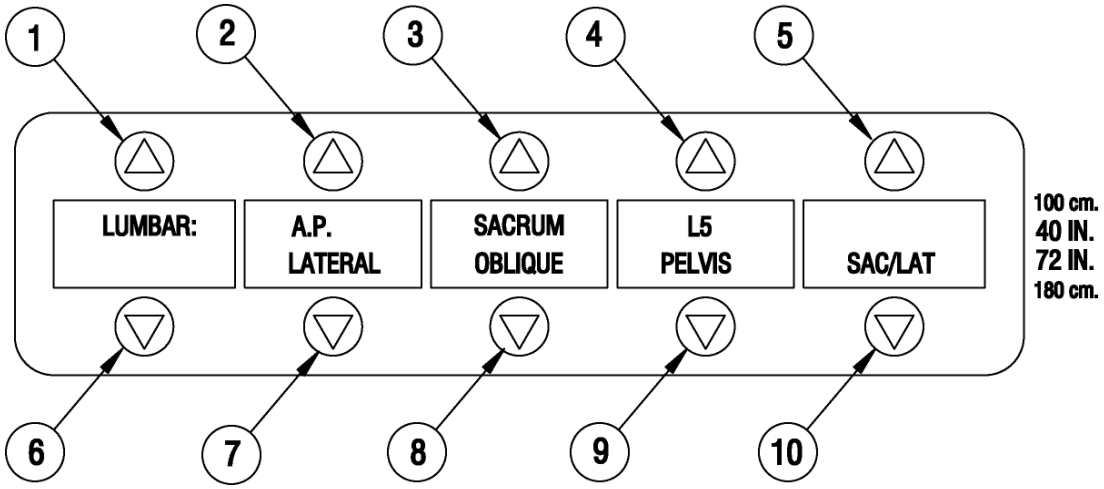


Figure 7-2 Anatomical View Selection Menu

4. To edit program press arrow keys marked 6 and 8 simultaneously. The selected Region of Interest (1) and Anatomical View (6) will be displayed (or blank for new view) in the main program edit menu as shown in Figure 7-2. Sector keys function as follows:

   a. **UP/DOWN** arrow keys (3 and 8) allow selection of alphanumeric characters at the designated (cursor) location.
   b. **Right** and **LEFT** sector keys (4 and 9) allow for movement of the location designated for edit (cursor).
   c. **NEXT** and **PREV** keys (5 and 10) allows you to advance to the next menu (or process) and return to previous menu/selection.

Auto-Tech Programming Procedures (Continued)

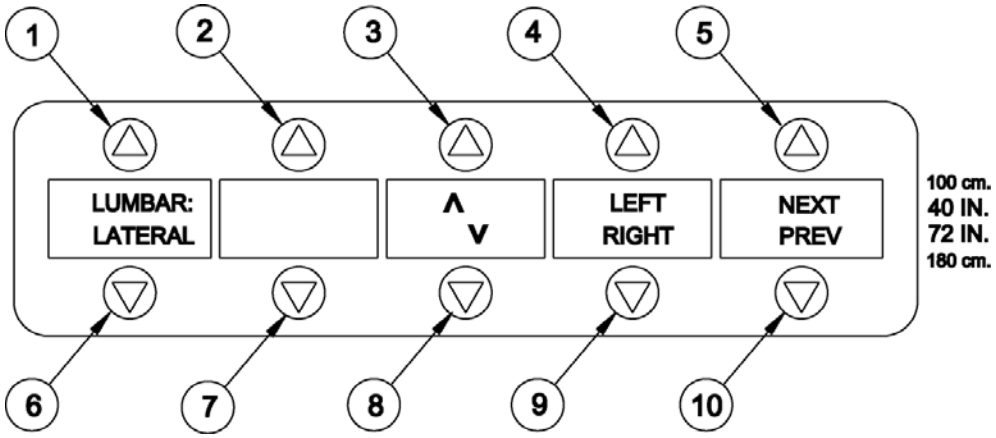


Figure 7-3 Main Program Edit Menu

5. To edit the displayed anatomical view, use the **RIGHT** or **LEFT** sector keys to position the cursor, then use the **up/down** arrow keys to select the desired alphanumeric character. You can name a view with up to seven alphanumeric characters. Blank spaces, the first selectable alphanumeric character before the letter **"A"**, are displayed as a blank in the appropriate space. When name editing is complete, press **NEXT** to advance to the **SID** and **mA Selection Menu**.

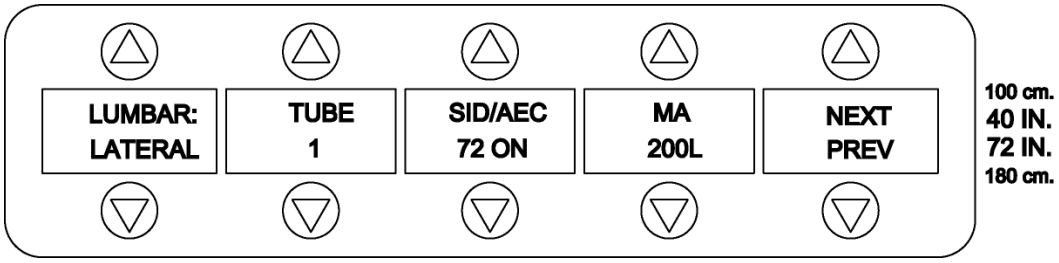


Figure 7-4 SID and mA Selection Edit Menu

Note: TUBE sector selection is disabled since these are single tube units.

Auto-Tech Programming Procedures (Continued)

6. Select the displayed **SID/AEC** setting by pressing the appropriate **up/down** key on the **SID/AEC** sector. You can also select an **AEC**-on feature (if optional AEC system is present), that will automatically enable **AEC** mode for the selected anatomical view. When **ON** is displayed under **AEC**, **AEC** mode will automatically be enabled for the selected view. Possibilities are : 40 or 72-inches with **AEC OFF** and 40 or 72-inches with **AEC ON.** Selected **SID** is indicated (in Auto-Tech mode) with a shaded arrow that points to the respective **SID** as indicated on the right side of the **OCP**.

7. Select an mA station to be used by pressing the appropriate up or down mA sector key to increase or decrease mA. When SID and mA sectors display the desired values, press **NEXT** to advance to the Bucky and CM Range Selection Menu (shown below).

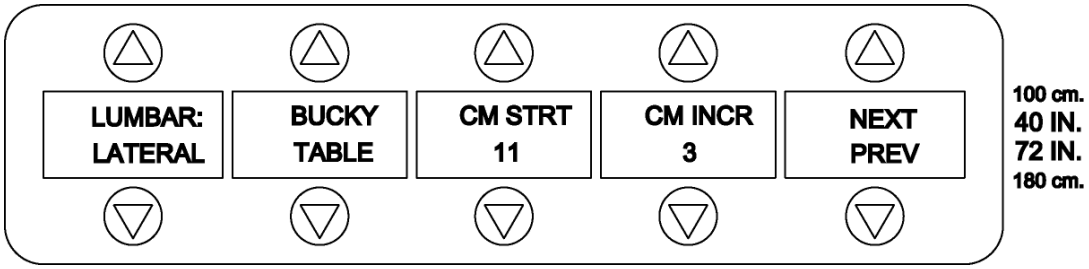


Figure 7-5 Bucky and CM Range Selection Edit Menu

8. Select BUCKY mode to be used by pressing the appropriate up/down key associated with the BUCKY sector. Possibilities are: WALL, TABLE, NON-W(all) and NON-T(able).

9. Select measurement parameters with the **CM STRT** and **CM INCR** sector as described below. The **CM STRT** sector defines that start value (lowest possible selection) for the selected anatomical view. Possible selections are 1 through 16. The **CM INCR** sector defines the value by which the CM measurement will be incremented each time the CM select key is pressed. There are ten available selections. For example, if **CM STRT** is 1 and **CM INCR** is 3 for a selected view, some CM selection possibilities would be 1, 4, 7, 10, etc. In general, you should establish a CM range for the selected view. The CM range is the total thickness range of the desired anatomical region. If the CM range is 10 or less, use 1 as a CM increment. If the range is between 11 and 20, use 2 as a CM increment. If the CM range is between 21 and 30, use 3 as a CM increment. If the range is over 30, use 4 as a CM increment.

   a. To increase or decrease **CM STRT** value, press the appropriate up/down sector key until the desired value is displayed.

Auto-Tech Programming Procedures (Continued)

b. To increase or decrease **CM INCR** value, press the appropriate up/down sector key until the desired value is displayed.
c. When BUCKY, CM STRT and CM INCR sectors display the desired values, press NEXT to advance to the Exposure Factor Selection Edit Menu (example shown below).

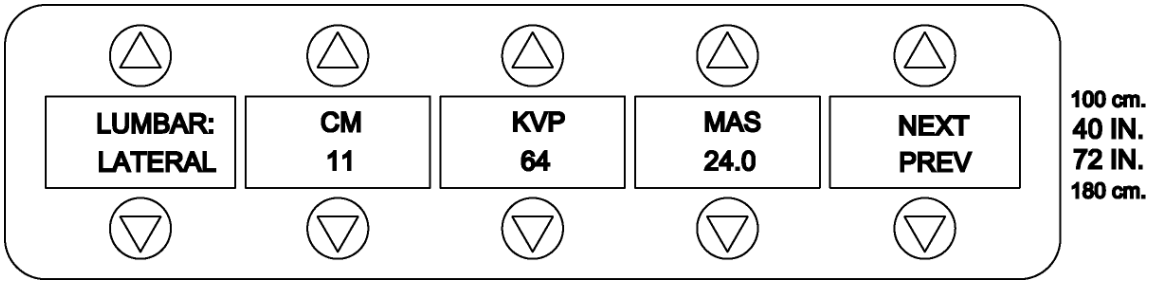


Figure 7-6 Exposure Factor Selection Edit Menu

10. You are now ready to select exposure factors for the selected view for each CM selection. For each CM setting, select a base kVp and mAs value. These set values can be manually modified for each individual exam, at random without returning to program edit mode.
    a. To increase or decrease displayed kVp setting, press the up/sown associated sector keys.
    b. To increase or decrease the displayed mAs setting, press the associated up/down sector keys. When the desired exposure factors for the displayed CM setting are displayed, press NEXT. Repeat step ll for each CM setting displayed.

    Note: If the optional AEC system is selected for this anatomical view, the AEC stop signal will terminate the x-ray. The programmed mAs setting will not be in effect (refer to Configure Operating Parameters in Section 6, Calibration for setting the AEC back-up time). The AEC may be turned off in this view by pressing the AEC key on the OCP.
    c. After the tenth CM setting has been set and NEXT is pressed, the edited x-ray techniques will be stored in memory. **"PLEASE WAIT"** will be displayed momentarily on the fifth sector. After the technique has been stored, the program edit menu will automatically advance to the next anatomical view. You can continue to edit or exit program edit mode.
11. To edit additional x-ray techniques, repeat this entire process as necessary for each. To exit program edit mode and return to normal operating mode, press **MANUAL** key.

PROGRAMMING UTILITIES

Utility/Maintenance Operations

The utility/maintenance menu provides access to perform test routines, copy **MASTER** and **EE Prom** program data and perform calibration and thickness measurement settings.

Note: If you need to connect a printer or remove or replace an Integrated Circuit (IC) chip, perform that procedure before you access the utilities menu.

Accessing Utility/Maintenance Menu

From Program Edit: When the Main Program Edit Menu (Figure 7-3, page 4) is displayed

From Normal Operating Mode:

Exit Utility Menu:

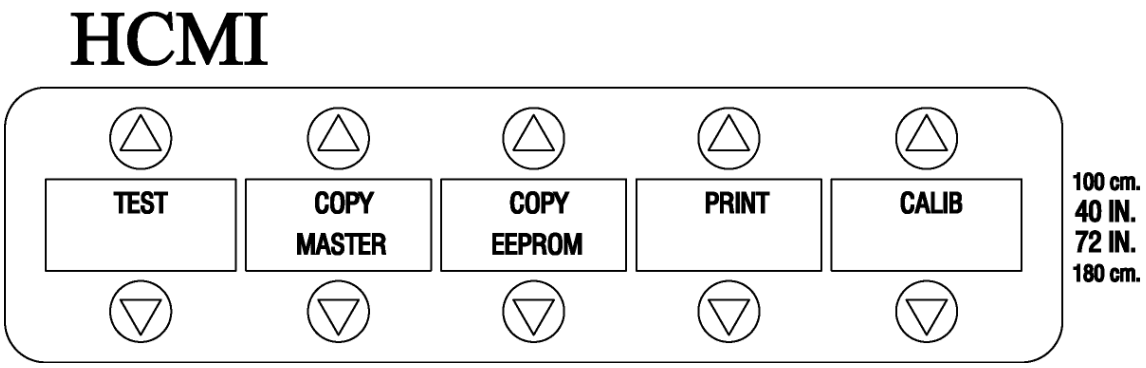


Figure 7-7 Utility Maintenance Menu

PROGRAMMING UTILITIES

Copy Master To EEProm

This procedure provides the information necessary to copy imaging technique data from ICs located in the Master socket (U26) to ICs placed in the EEProm socket (U3) of the microprocessor board (A-172/272). Any imaging technique data resident on the IC in the EEProm socket will be erased and overwritten with the imaging technique data of the IC located in the Master socket. All other data resident on the EEProm socket IC (including calibration data) will remain unaffected. Proceed as follows:

1. Turn power **OFF** and remove the cover panel to access the microprocessor board. Insert master **EEProm** into Master socket (U26) on the microprocessor board (A-172/272).

2. Turn power **ON** and access the Utility/Maintenance Menu as described on page 70.

3. Press the **Copy Master sector key**,. The LCD panel will display (Fig. 7-9).

   a. To continue with copy procedure; press **YES.** Resident **EEProm** imaging technique data will be erased and imaging technique data contained on the IC in the Master socket will be copied onto the IC in the **EEProm** socket. Current copy status (address locations) will be updated/displayed in the last LCD segment.

   b. To abort the copy procedure, press **NO.** Any imaging technique data existing on the IC in the **EEProm** socket will remain and Master IC imaging technique data will not be copied.

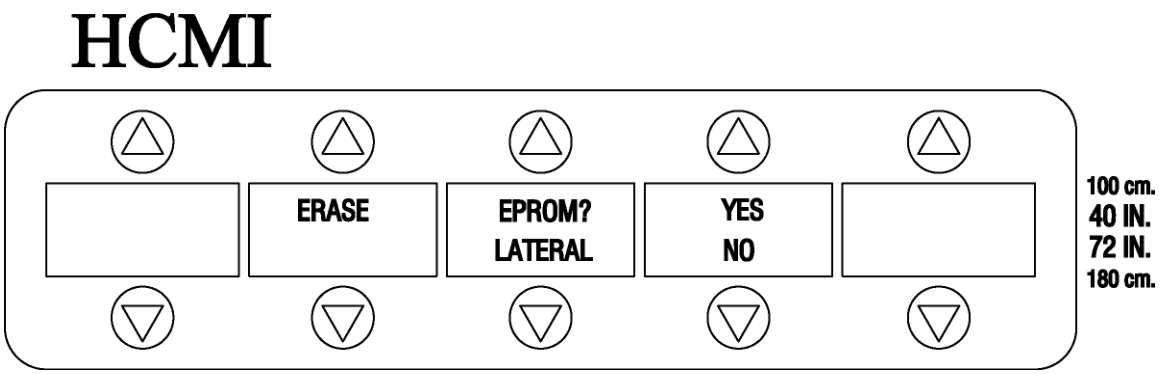


Figure 7-9 Copy MASTER Verification Menu

4. When the procedure is complete, turn power **OFF**, remove IC's as necessary and re-install cover panel.

PROGRAMMING UTILITIES

Copy EEProm to Master

This procedure provides the information necessary to copy data from IC's located in the **EEProm** socket (U3) to IC's placed in the Master socket (U26) of the microprocessor board (A-172/272). Any data resident on the IC in the Master socket will be erased and overwritten with the **entire data** content of the IC in the **EEProm** socket. Proceed as follows:

1. Turn power **OFF** and remove the cover panel to access the microprocessor board.

2. Insert an **EEProm** into the Master socket (U26) on the microprocessor board (A-172/272).

3. Turn power **ON** and access the Utility/Maintenance Menu (as described in Section F, Calibration, Figure 6-11, page 7).

4. Press the Copy **EEProm** sector key. The LCD will display:

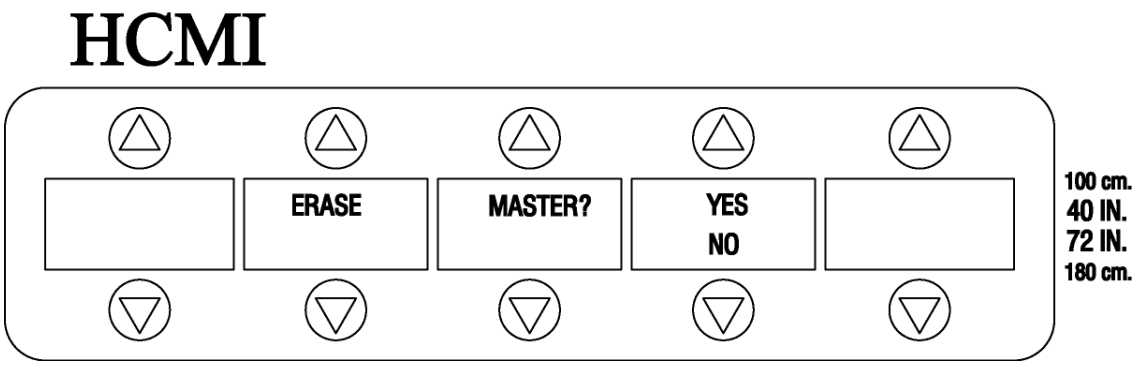


Figure 7-10 Copy EEProm Verification Menu

   a. To continue with copy procedure, press YES. Resident EEProm technique and calibration data will be copied to the Master Current copy status (address locations) will be updated/displayed in the last LCD segment.

   b. To abort the copy procedure, press **NO**. Any data existing on the Master will remain and **EEProm** data will not be copied.

5. When the procedure is complete, turn power **OFF**, remove IC's as necessary and re-install cover panel.

PROGRAMMING UTILITIES

Print

This program allows you to print all techniques stored in Auto-Tech memory. If a printer is already connected to your system, continue with this step. If not, refer to Connecting a Printer in Section E, Installation.

1. Press **PRINT** sector key. Printing will be displayed on the LCD while the printer provides you with a hard copy of all techniques stored in memory.
2. When printing is complete, the Utility/maintenance Menu will be re-displayed.

Calibration

This program allows you to calibrate the D.C. reference measurement, the kVp accuracy and the mA accuracy. For detailed procedures, refer to Section F, Calibration.

SECTION H

PLANNED MAINTENANCE

Introduction

This section is designed to assist the system user and service technician in maintaining the smooth operation of the HF Series generator.

Maintenance and Service Guidelines

In order to keep the HCMI, Inc. HF Series operating properly, it must be inspected and calibrated at regular intervals, depending on the age and use of the equipment. If a problem arises, call an HCMI, Inc. service technician. Do not operate equipment until all repairs are completed.

Maintenance Procedures

Scheduled planned maintenance should be performed every twelve (12) months. This includes cleaning, electrical and mechanical adjustments. So that the system remains in good working order and is insured of operational reliability, this schedule should be maintained. It is recommended that the service technician be prepared with the Service Kit, P/N M-230 for HF Series generators. The standard tools and materials required for testing and calibration are as follows:

- Alignment tool, cassettes and film
- Digital voltmeter Fluke Model 87 (or equivalent)
- Dynalyzer III or equivalent
- mAs meter Fluke PM 2618 (or equivalent)
- Oscilloscope 50 mHz storage Tek 2210 (or equivalent)
- Sensitometer X-Rite Model 303 (or equivalent)
- Densitometer X-Rite Model 301 (or equivalent)

Please refer to Table 8-2, Maintenance Checklist, as a guide in performing the required visual, mechanical and electrical inspection/adjustment procedures.

WARNING: Replace only with same type and rating of fuse to protect against risk of fire.

CAUTION: Dispose of batteries (i.e., stored energy cells) in accordance with all federal, state and local regulations.

Electrical Maintenance

Caution: This equipment contains electrostatic sensitive devices. Observe proper grounding precautions before handling components or PCB's.

Electrical Maintenance continued

Use the Calibration Checklist, Table 8-1 and accompanying data sheets and verify that all calibrations are within specified tolerances an stated in Section B, General Information; this is required to demonstrate compliance. The Calibration Checklist corresponds to the procedure sequence in Section F, Calibration. If necessary, calibrate according to the procedures in Section F, Calibration.

Table 8-1

HCMI, Inc. HF Series Calibration Checklist

Serial Number_____

Reference Voltage_____
Source Charger Voltage (Se only) _____
Filament Voltage Supply_____
Regulated Power Supply +/-15 VDC_____
KVP Alignment_____
Set-up_____
KVP Calibration_____
mA Calibration_____
Maximum Deviation: kVp, time, mA, mAs_____
_____
Linearity_____
Reproducibility_____

For Systems with AEC option:
AEC Calibration_____
AEC Linearity_____
AEC Reproducibility_____

Calibrated By: _____ Date: _____

PLANNED MAINTENANCE

Series HF-300

Limits:

Maximum Deviation: kVp, Time, mA, mAs

mA: +/- 10% or 5mA
kVp: +/- 5%
Time: +/- 1% or 3 milliseconds

HF-300 Serial Number_____
Tube Serial Number_____

Record mA (Time = 100 Milliseconds):

	25S	150S	100L	150L
50 kVp				
70 kVp				
90 kVp				
110 kVp				

Record kVp (Time = 100 Milliseconds):

	25S	150S	100L	150L
50 kVp				
70 kVp				
90 kVp				
110 kVp				

Test Unit at Following Settings:

		kVp	mA	Time	mAs
1.	**Setting**	**40**	**75S**	**500 ms**	**37.5**
	Reading				
1.	**Setting**	**60**	**75L**	**10ms**	**0.75**
	Reading				
1.	**Setting**	**80**	**150L**	**50ms**	**7.5**
	Reading				
1.	**Setting**	**100**	**100L**	**3 sec.**	**300**
	Reading				
1.	**Setting**	**120**	**125L**	**100ms**	**12.5**
	Reading	-------	--------	--------	-------

PLANNED MAINTENANCE

Series HF-300 (Continued)

Settings for Linearity

	NON AEC		AEC	
	Test 1	Test 2	Test 1	Test 2
KVp	80	80	50	50
MA	150L	200L	75S	150S
mAs	15	20	———	———

Settings for Reproducibility

	NON AEC	AEC
KVp	100	55
mA	150S	25S
Time	20msec	_____

PLANNED MAINTENANCE

Series HF-600

Limits:

Maximum Deviation: kVp, Time, mA, mAs

mA: +/- 10% or 5 mA
kVp :+ /- 5%
Time: +/- 1% or 3 milliseconds

HF-600 Serial Number_____
Tube Serial Number_____

Record mA (time = 100 milliseconds):

	25S	75S	200L	300L	400L
50 kVp					
70 kVp					
90 kVp					
110 kVp					n/a

Record kVp (time = 100 milliseconds):

	25S	75S	200L	300L	400L
50 kVp					
70 kVp					
90 kVp					
110 kVp					n/a

Test Unit at Following Settings:

	kVp	mA	Time	mAs
1. Setting	40	500L	250ms	125
Reading				
2. Setting	60	600L	20ms	12
Reading				
3. Setting	80	150S	50ms	7.5
Reading				
4. Setting	100	75S	3 sec.	225
Reading				
5. Setting	125	200L	150ms	30
Reading	--------	--------	--------	-------

PLANNED MAINTENANCE

Series HF-600 (Continued)

Settings for Linearity

	NON AEC		AEC	
	Test 1	Test 2	Test 1	Test 2
KVp	80	80	50	50
MA	300L	400L	300L	200L
mAs	30	40	———	———

Settings for Reproducibility

	NON AEC	AEC
KVp	100	55
mA	150S	75S
Time	20msec	_____

PLANNED MAINTENANCE

Series HF-3 SE/HF-3SEE

Limits:

Maximum Deviation: kVp, Time, mA, mAs

mA: +/- 10% or 5 mA
kVp: +/-5%
Time: +/- 1% or 3 milliseconds

HF-300 SE Serial Number_____
Tube Serial Number_____

Record mA (Time = 100 milliseconds):

	75S	100L	200L	300L
50 kVp				
70 kVp				
90 kVp				
110 kVp				

Record kVp (Time = 100 milliseconds):

	75S	100L	200L	300L
50 kVp				
70 kVp				
90 kVp				
110 kVp				

Test Unit at Following Settings:

		kVp	mA	Time	mAs
1.	Setting	40	25S	500ms	12.5
	Reading				
2.	Setting	60	250L	10ms	2.5
	Reading				
3.	Setting	80	300L	50ms	15
	Reading				
4.	Setting	100	100L	3 sec.	300
	Reading				
5.	Setting	120	250L	100ms	25

PLANNED MAINTENANCE

Series HF-3 SE/HF-3SEE (Continued)

Settings for Linearity

	NON AEC		AEC	
	Test 1	Test 2	Test 1	Test 2
KVp	80	80	50	50
MA	300L	250L	100L	200L
mAs	30	25	———	———

Settings for Reproducibility

	NON AEC	AEC
KVp	100	55
mA	300S	75S
Time	10msec	_____

PLANNED MAINTENANCE

Linearity Test Average Exposure Ratio

HF Series Serial Number: _____
Tube Serial Number: _____

$$\frac{X1 - X2}{X1 + X2} \leq 0.1$$

Test 1
Nominal Settings
kVp = 80
mA =_____
Time = 100 milliseconds
mAs =_____

Exp. MR
A1_____
A2_____
A3_____
A4_____
A5_____
A6_____
A7_____
A8_____
A9_____
A10_____
Sum._____
Avg._____

Test 2
Nominal Settings
kVp = 80
mA =_____
Time = 100 milliseconds
mAs =_____

Exp. MR
B1_____
B2_____
B3_____
B4_____
B5_____
B6_____
B7_____
B8_____
B9_____
B10_____
Sum._____
Avg._____

X1 = Avg / mAs =_____

X2 = Avg / mAs =_____

$$\frac{X1 - X2}{X1 + X2} = _____$$

Test 3
Reproducibility
Set exposure factors to: 100 kVp, _____ mA and 100 milliseconds.
C.O.V._____ < 0.05

Calibrated by: _____ **Date: _____**

PLANNED MAINTENANCE

AEC Linearity Test Average Exposure Ratio

HF Series Serial Number: _____
Tube Serial Number: _____

Setting	HF-300/3 SE	HF-600	Setting	HF-300/3 SE	HF-600
kVp	80	80	kVp	80	80
mA			mA		
Time (ms.)	100	100	Time (ms.)	100	100
mAs	15	30	mAs	20	40

Test 1
Nominal Settings
kVp = 50
mA =_____
Density = N (normal)
Water (inches) 5 in field

Exp. MR
A1_____
A2_____
A3_____
A4_____
A5_____
A6_____
A7_____
A8_____
A9_____
A10_____
Sum_____
Avg._____
X1 =Avg_____

Test 2
Nominal Settings
kVp = 50
mA =_____
Density = N (normal)
Water (inches) 5 in field

Exp. MR
B1_____
B2_____
B3_____
B4_____
B5_____
B6_____
B7_____
B8_____
B9_____
B10_____
Sum_____
Avg._____
X2 = Avg_____

$\frac{X1 - X2}{X1 + X2} =$_____

$\frac{X1 - X2}{X1 + X2} \leq 0.1$

Test 3

ACE Reproducibility
Set exposure factors to: 55 kVp, _____ mA +5 Density with 5 inches of water in the field.
C.O.V. _____ $\leq$ 0.05

Calibrated By:_____Date:_____

PLANNED MAINTENANCE

Maintenance Checklist

Table 8-2

Serial Number:_____

Operator Control Panel (OCP) buttons functioning properly? ___yes ____no

Operator Control Panel (OCP) LCD segments functioning properly? ___yes ___no

Operator Control Panel (OCP) LEDS functioning properly? ___yes ___no

Are safety interlocks in place and functioning? ___yes ___no

Remove cabinet covers. Check:

- **Mounting hardware**
- **Support brackets**
- **Wiring**
- **Connectors**
- **Repair, replace or secure as necessary**

Are all cabinet covers in place and secure?

Visually inspect all external cables and wiring for use

Verify calibration checklist. Are all items complete? ____yes ____no

Perform diagnostic test utility routines. RECORD ERRORS

_____

_____

Inspect recent films for image quality/artifacts. RECORD

_____

_____

Operators Comments:_____

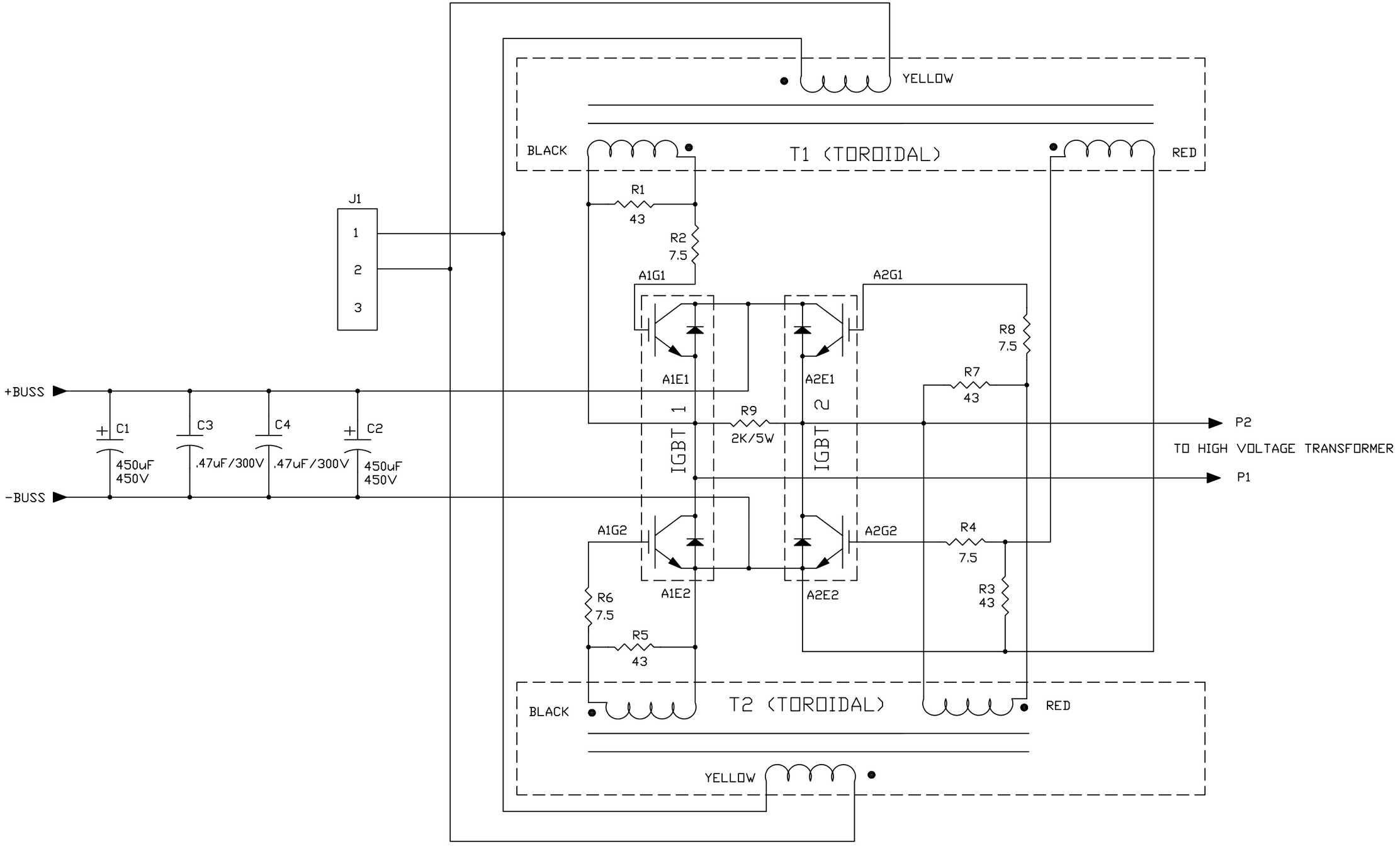
_____

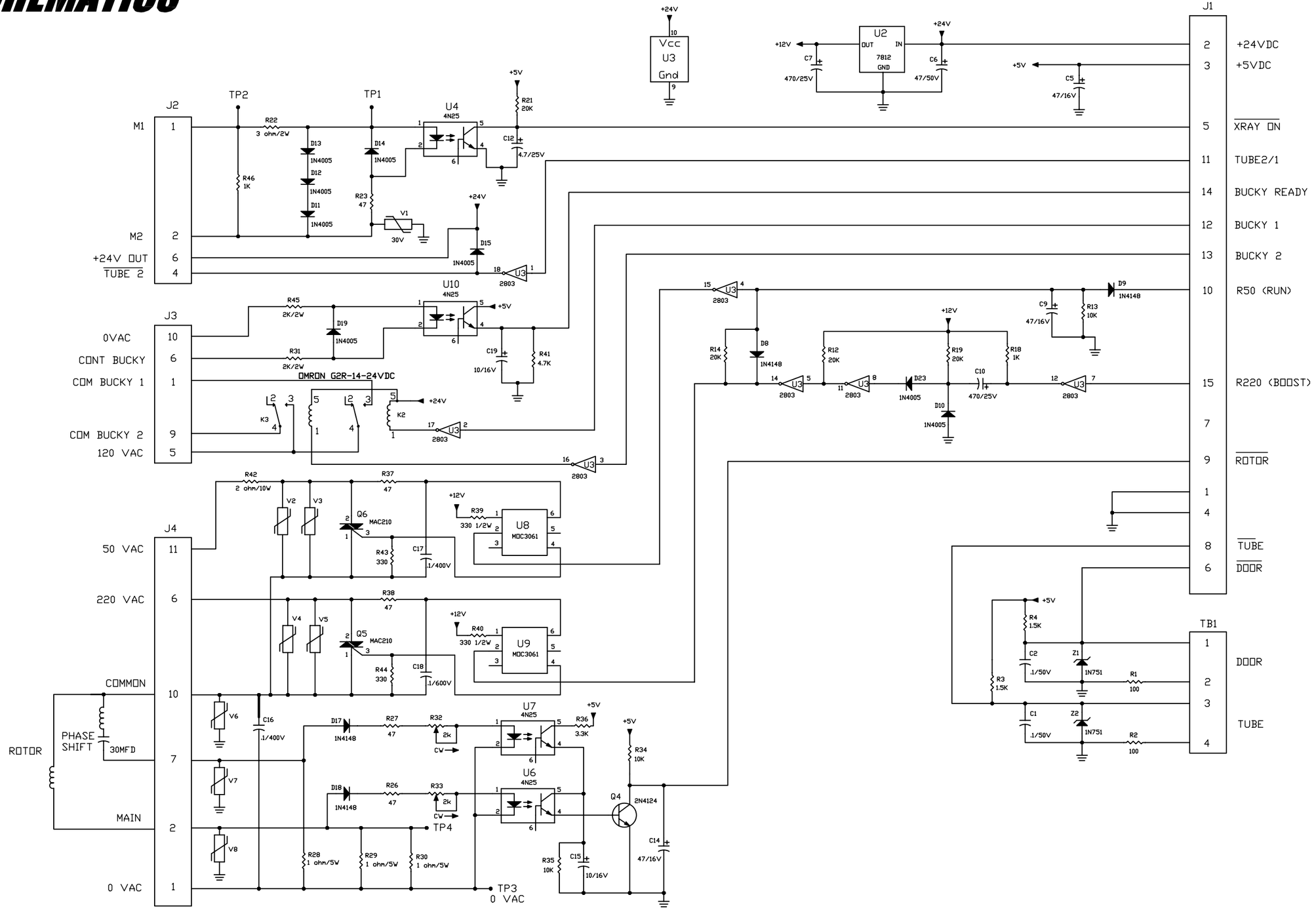
_____

Checked by:_____ Date:_____

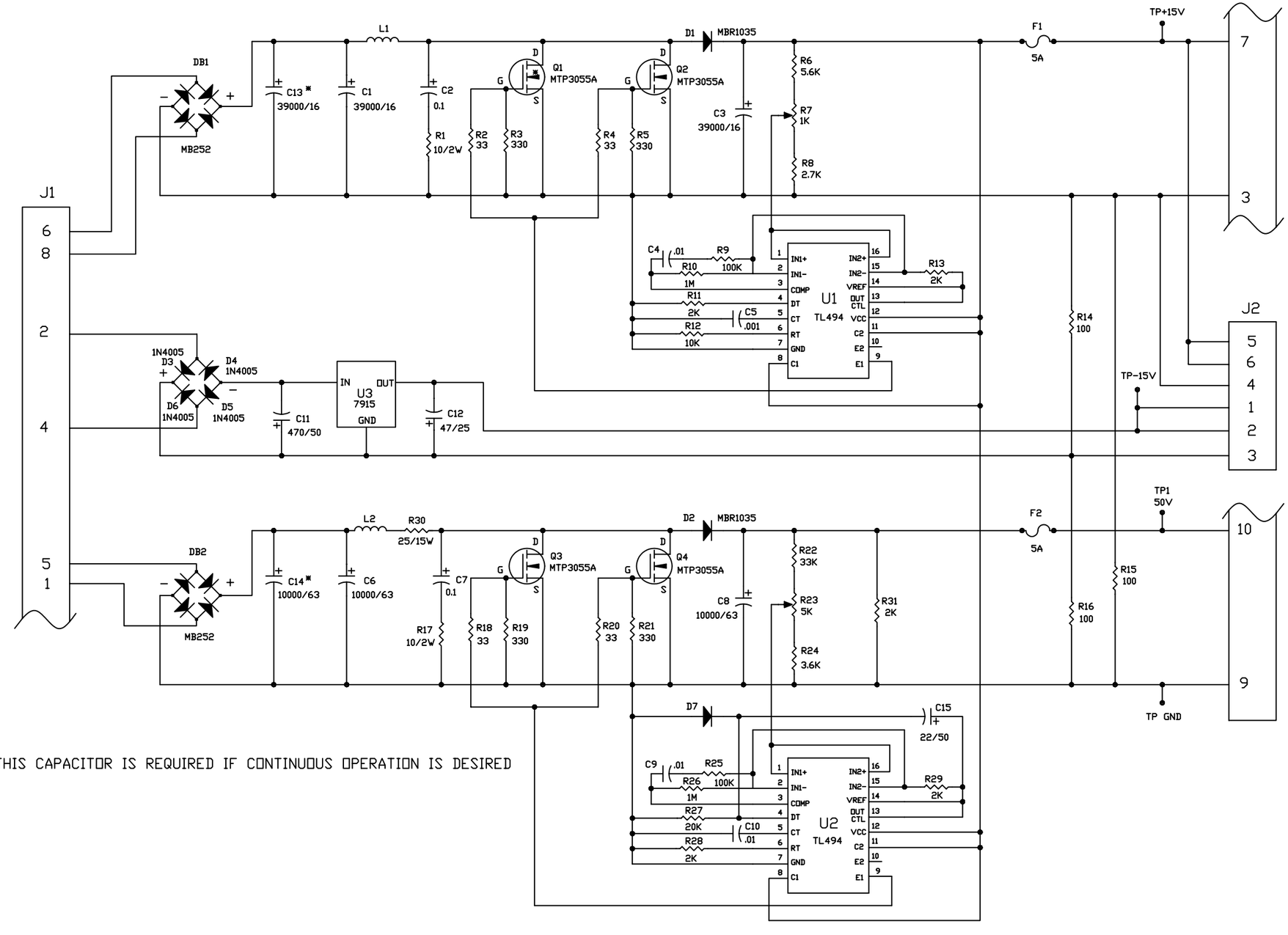
SECTION I

SCHEMATICS


YELLOW
BLACK
T1 (TOROIDAL)
RED
J1
1
2
3
R1
43
R2
7.5
A1G1
A2G1
R8
7.5
R7
43
A1E1
A2E1
+BUSS
C1
450uF
450V
C3
.47uF/300V
C4
.47uF/300V
C2
450uF
450V
-BUSS
IGBT 1
IGBT 2
R9
2K/5W
P2
TO HIGH VOLTAGE TRANSFORMER
P1
A1G2
A2G2
R4
7.5
R3
43
A1E2
A2E2
R6
7.5
R5
43
BLACK
T2 (TOROIDAL)
RED
YELLOW


J1
2 +24VDC
3 +5VDC
5 XRAY ON
11 TUBE2/1
14 BUCKY READY
12 BUCKY 1
13 BUCKY 2
10 R50 (RUN)
15 R220 (BOOST)
7
9 ROTOR
1
4
8 TUBE
6 DOOR
J2
M1 1
M2 2
+24V OUT 6
TUBE 2 4
J3
0VAC 10
CONT BUCKY 6
COM BUCKY 1 1
COM BUCKY 2 9
120 VAC 5
J4
50 VAC 11
220 VAC 6
COMMON 10
ROTOR
PHASE SHIFT
30MFD
7
MAIN 2
0 VAC 1
TP1
TP2
TP3 0 VAC
TP4
U2 7812
U3 Vcc Gnd
U4 4N25
U6 4N25
U7 4N25
U8 MOC3061
U9 MOC3061
U10 4N25
2803
OMRON G2R-14-24VDC
K2
K3
Q4 2N4124
Q5 MAC210
Q6 MAC210
D8 1N4148
D9 1N4148
D10 1N4005
D11 1N4005
D12 1N4005
D13 1N4005
D14 1N4005
D15 1N4005
D17 1N4148
D18 1N4148
D19 1N4005
D23 1N4005
Z1 1N751
Z2 1N751
V1 30V
V2
V3
V4
V5
V6
V7
V8
TB1
1
2 DOOR
3
4 TUBE
+24V
+12V
+5V
R1 100
R2 100
R3 1.5K
R4 1.5K
R13 10K
R14 20K
R12 20K
R19 20K
R18 1K
R21 20K
R22 3 ohm/2W
R23 47
R27 47
R26 47
R37 47
R38 47
R42 2 ohm/10W
R45 2K/2W
R31 2K/2W
R41 4.7K
R46 1K
R32 2k CW
R33 2k CW
R34 10K
R35 10K
R36 3.3K
R39 330 1/2W
R40 330 1/2W
R43 330
R44 330
R28 1 ohm/5W
R29 1 ohm/5W
R30 1 ohm/5W
C5 47/16V
C6 47/50V
C7 470/25V
C9 47/16V
C10 470/25V
C12 4.7/25V
C14 47/16V
C15 10/16V
C16 .1/400V
C17 .1/400V
C18 .1/600V
C19 10/16V
C1 .1/50V
C2 .1/50V

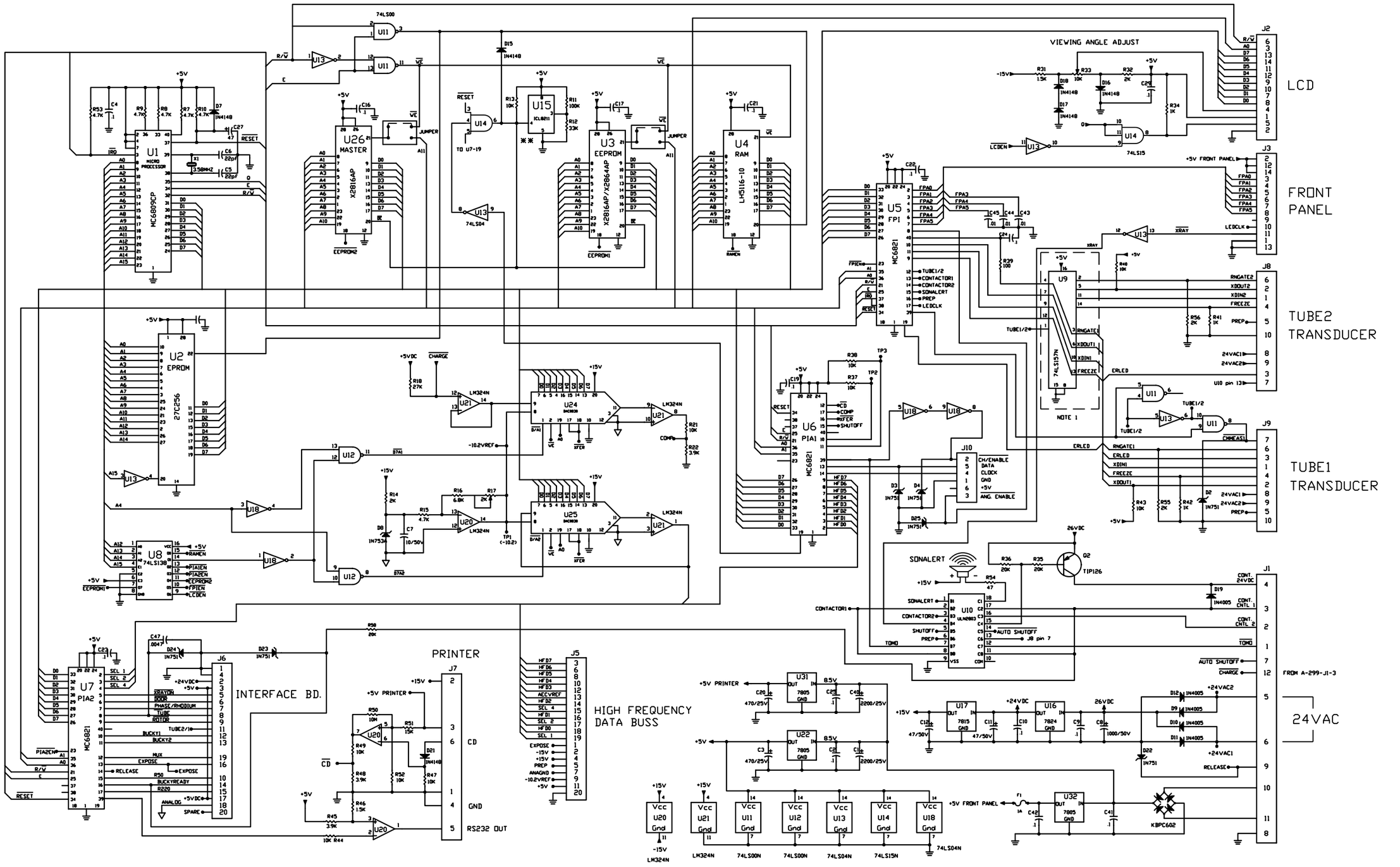
SCHEMATICS



*THIS CAPACITOR IS REQUIRED IF CONTINUOUS OPERATION IS DESIRED

SCHEMATICS

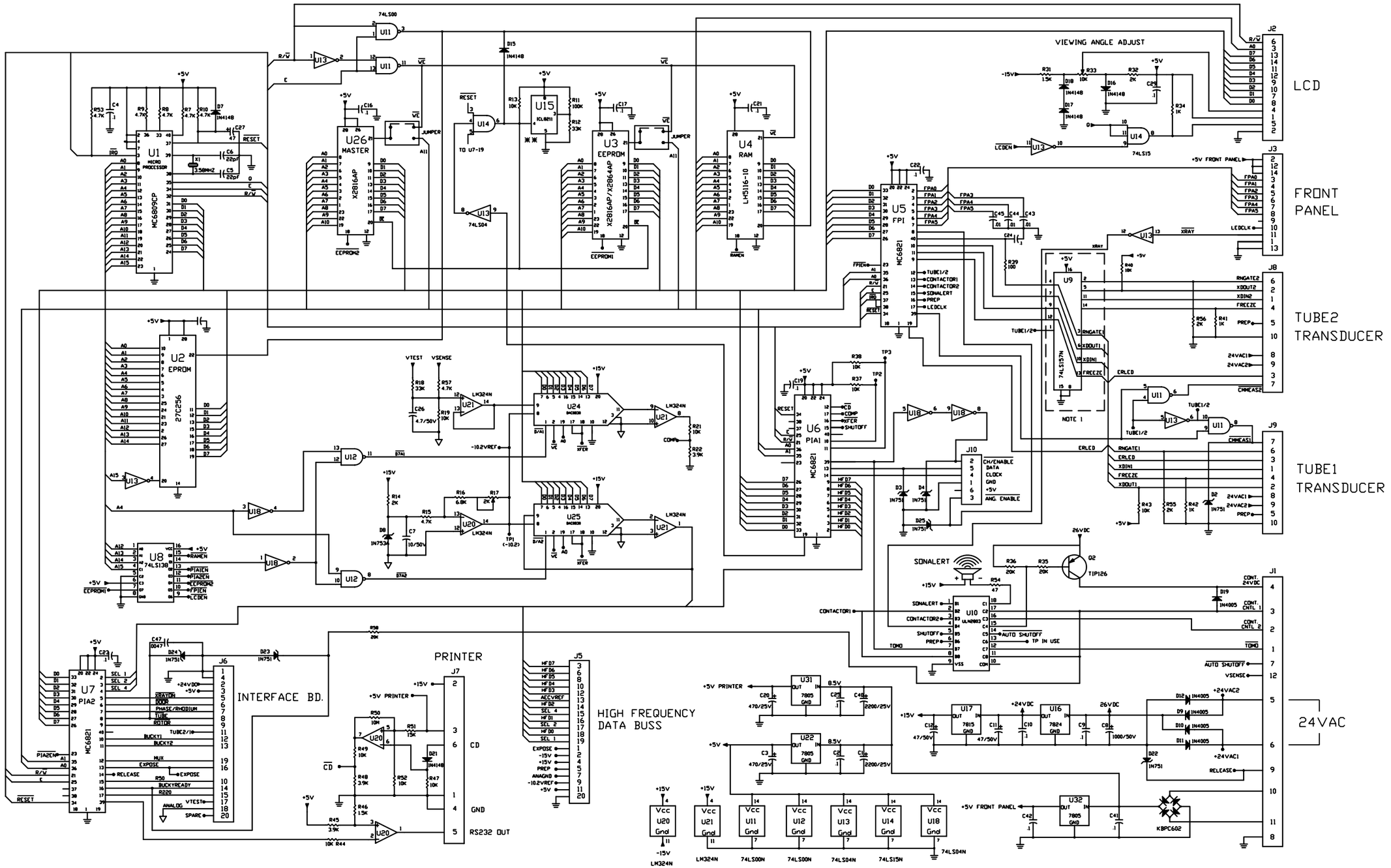
**Note: U15 Removed 5/15/03.



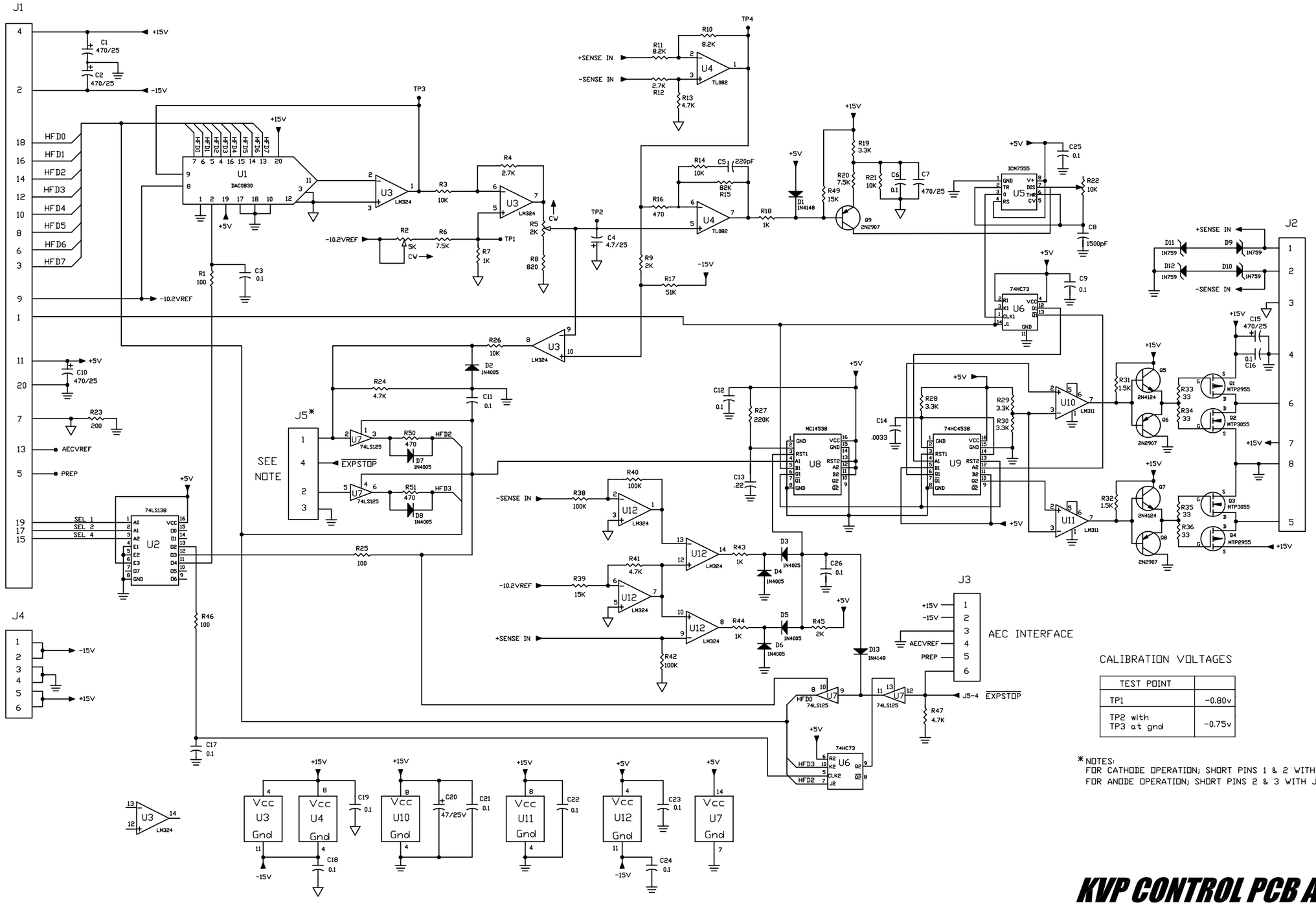
MICROPROCESSOR PCB A-272

SCHEMATICS

**Note: U15 Removed 5/15/03.



SCHEMATICS



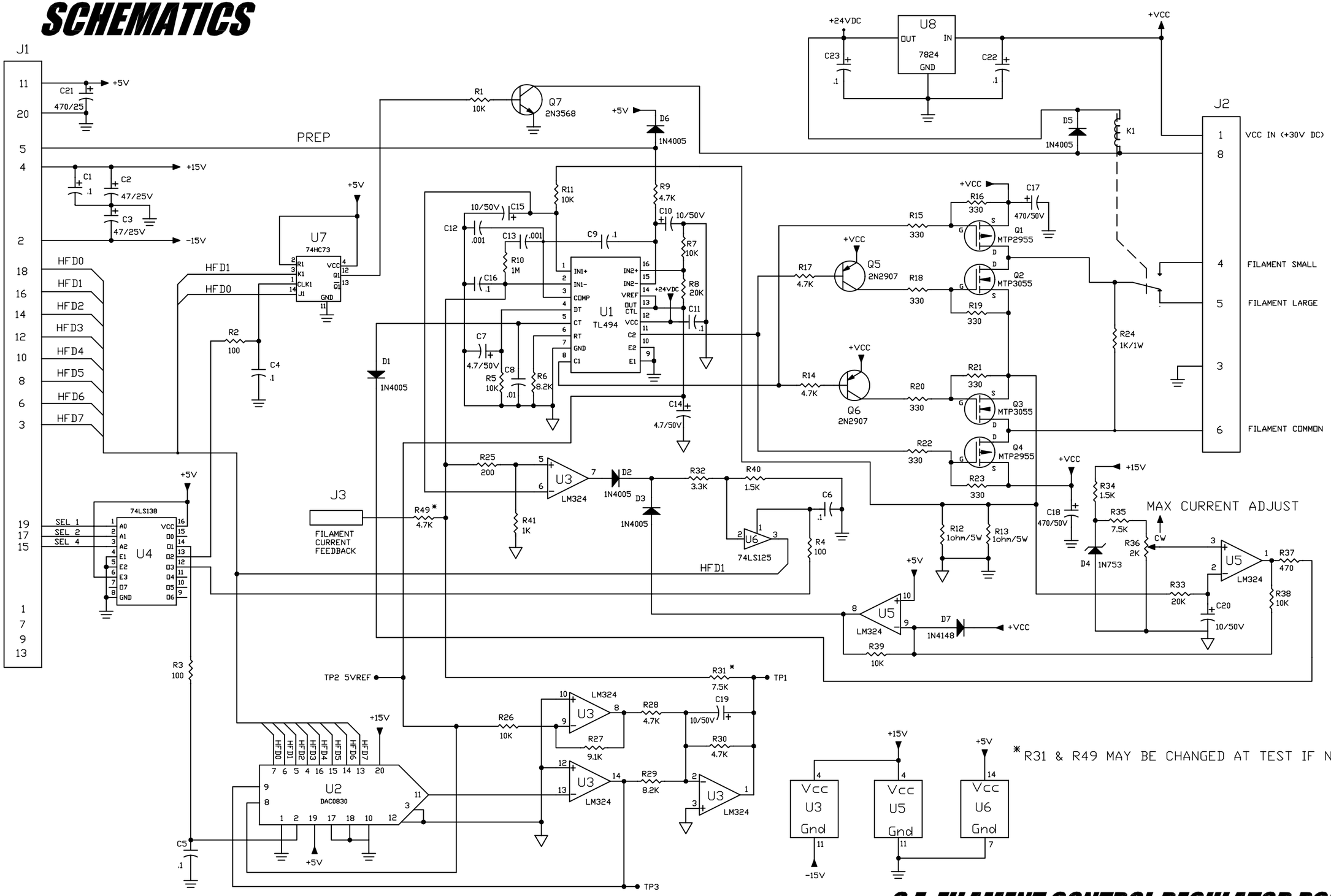
CALIBRATION VOLTAGES

TEST POINT	
TP1	-0.80v
TP2 with TP3 at gnd	-0.75v

*NOTES:
FOR CATHODE OPERATION; SHORT PINS 1 & 2 WITH JUMPER ON J5
FOR ANODE OPERATION; SHORT PINS 2 & 3 WITH JUMPER ON J5

KVP CONTROL PCB A-189

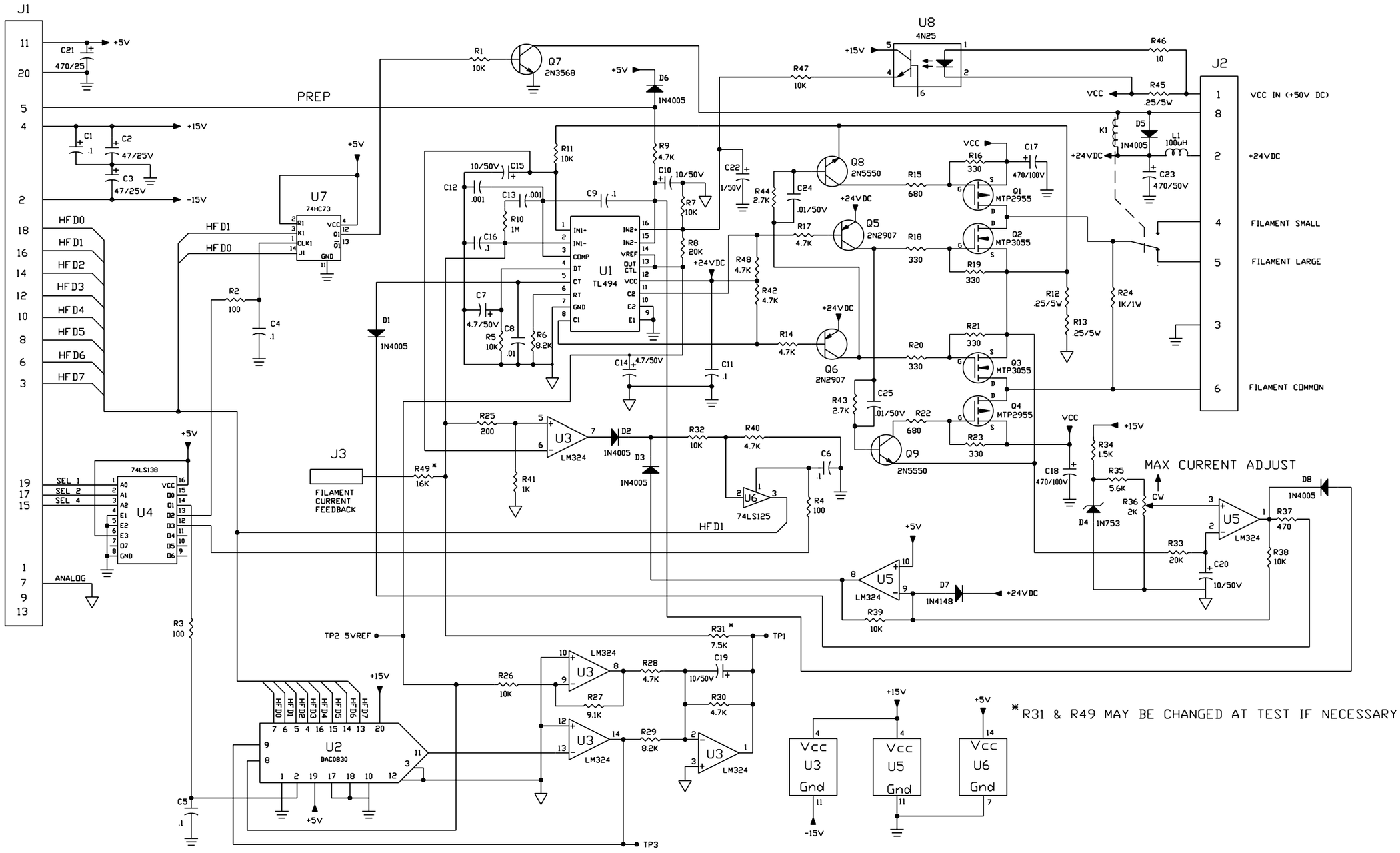
SCHEMATICS



* R31 & R49 MAY BE CHANGED AT TEST IF NECESSARY

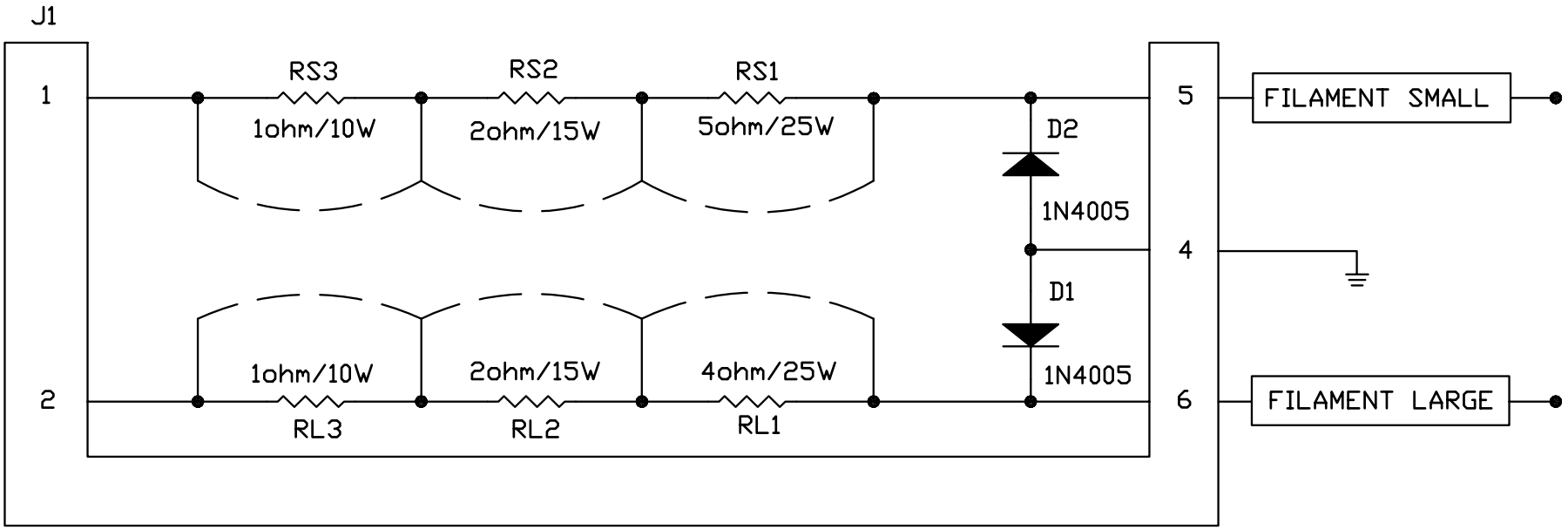
S.E. FILAMENT CONTROL REGULATOR PCB A-190

SCHEMATICS



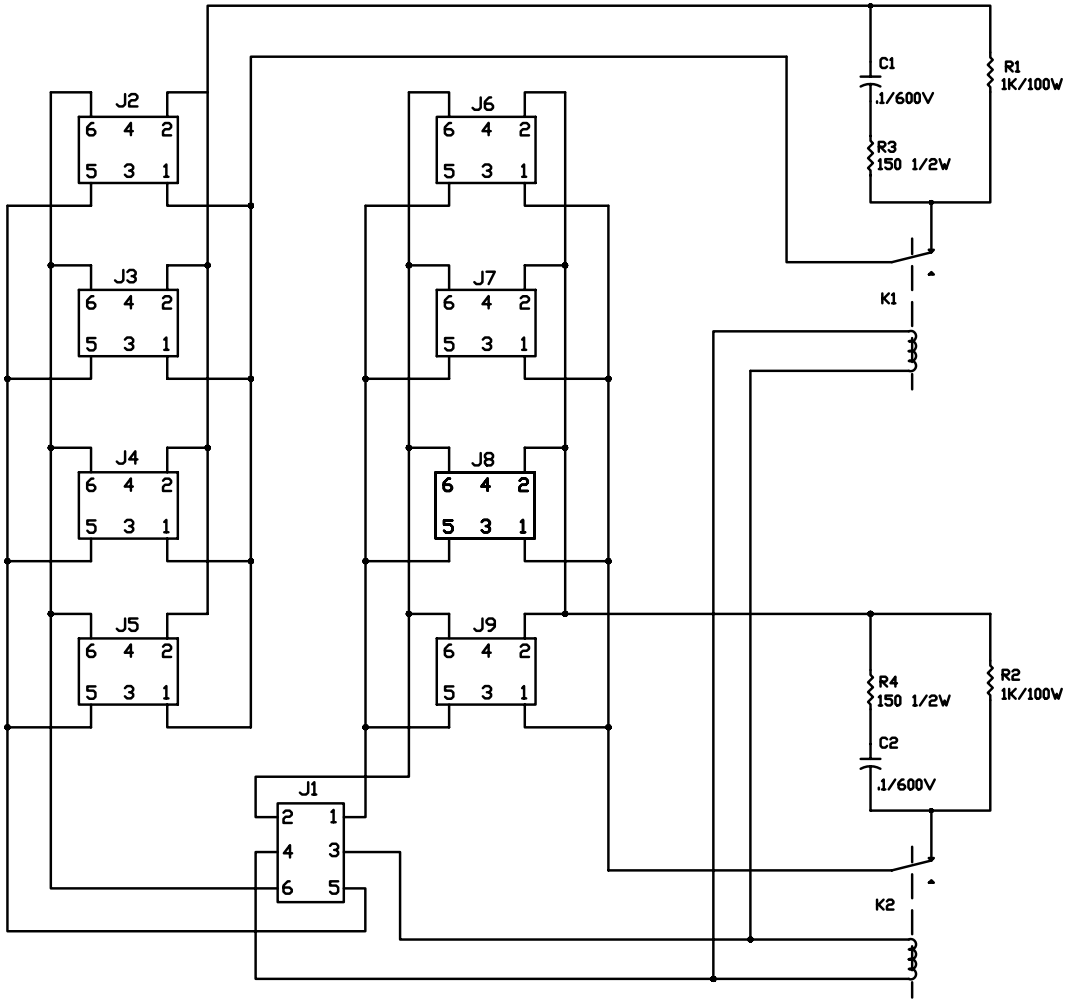
FILAMENT CONTROL REGULATOR PCB A-263

SCHEMATICS



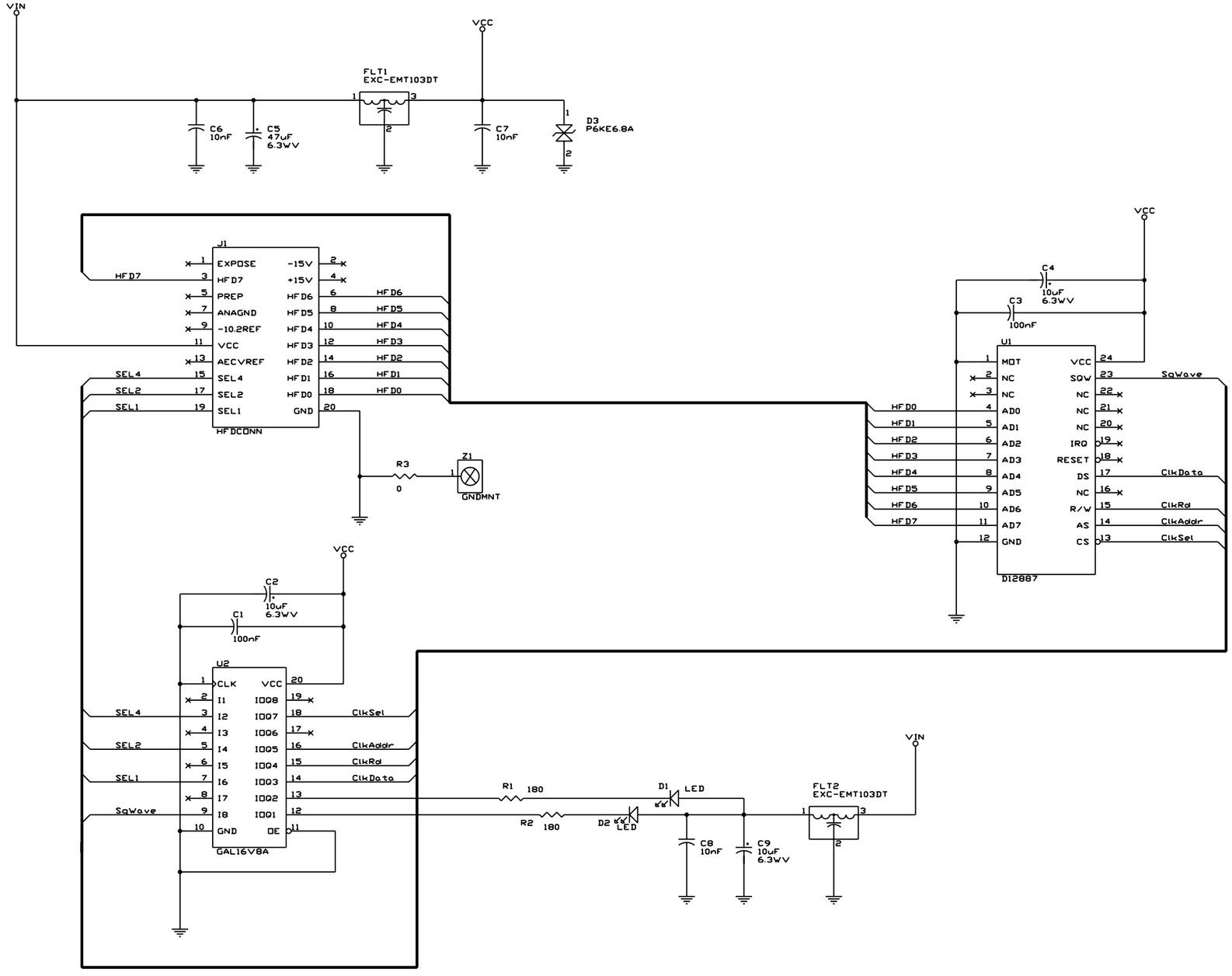
FILAMENT RESISTOR PCB A-186

SCHEMATICS

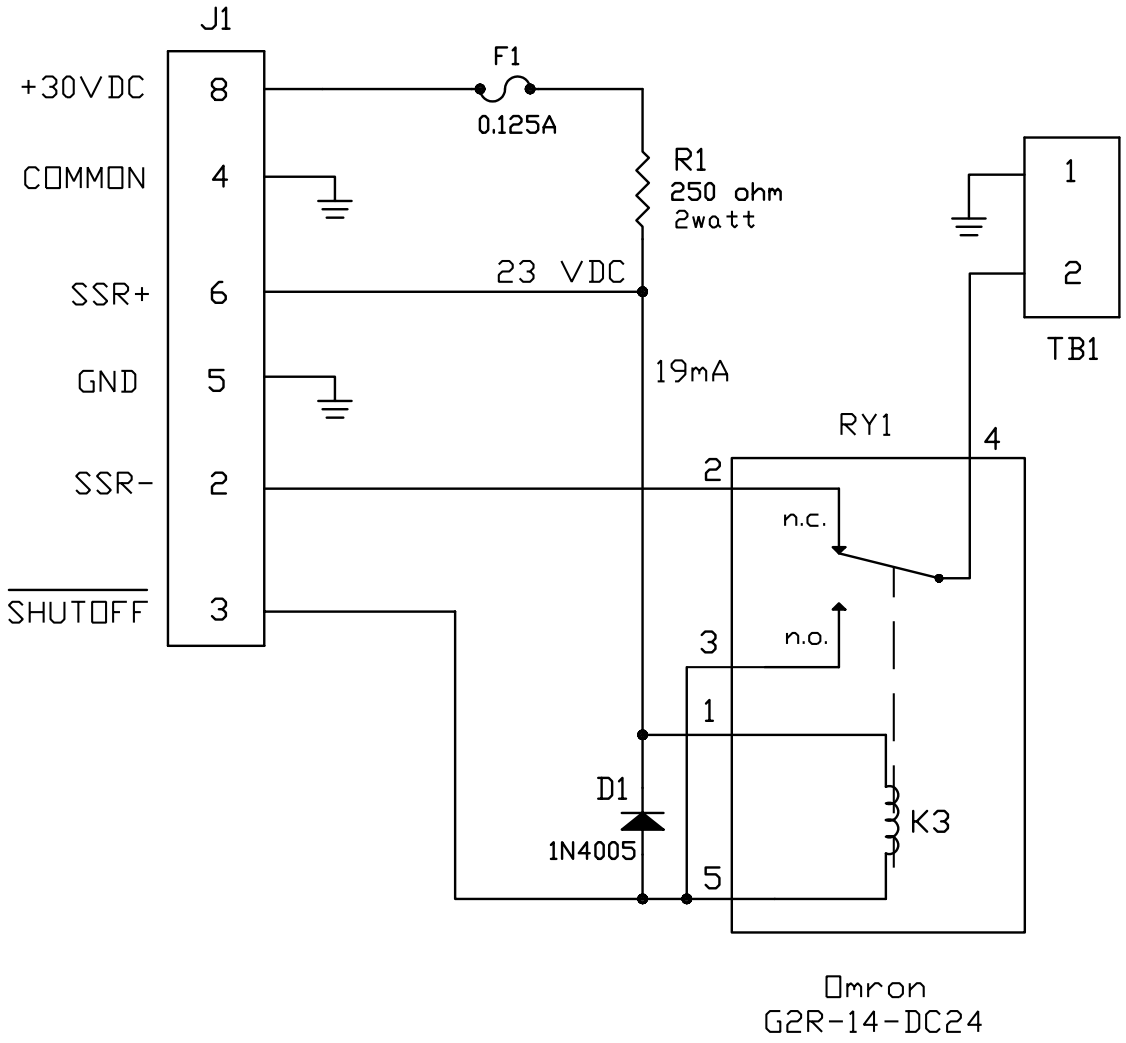


DISTRIBUTION PCB A-185

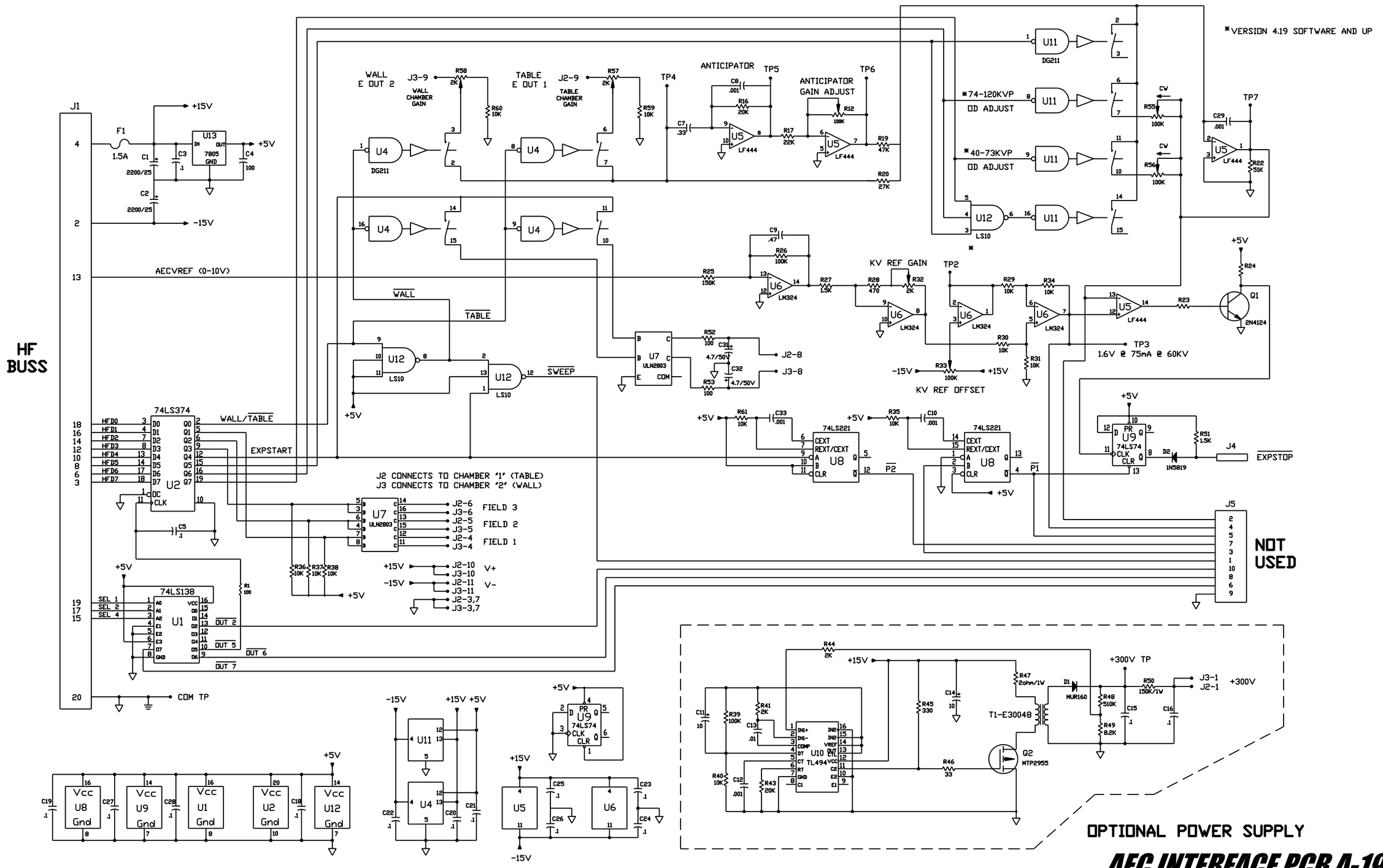
SCHEMATICS



CODE BOARD PCB A-911

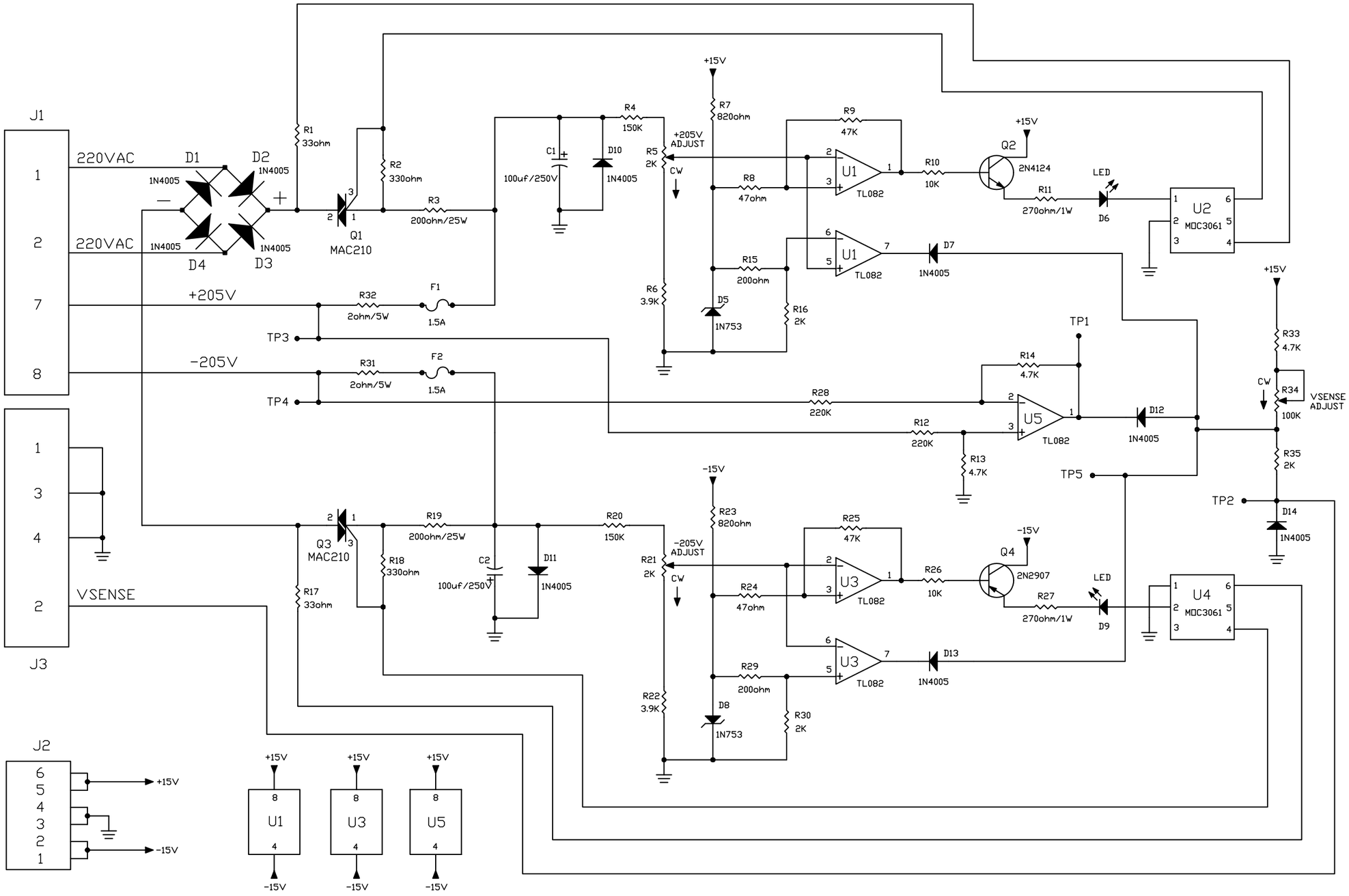

J1
+30VDC
8
COMMON
4
SSR+
6
GND
5
SSR-
2
SHUTOFF
3
F1
0.125A
R1
250 ohm
2watt
23 VDC
19mA
1
2
TB1
RY1
4
2
n.c.
n.o.
3
1
D1
1N4005
K3
5
Omron
G2R-14-DC24

SCHEMATICS

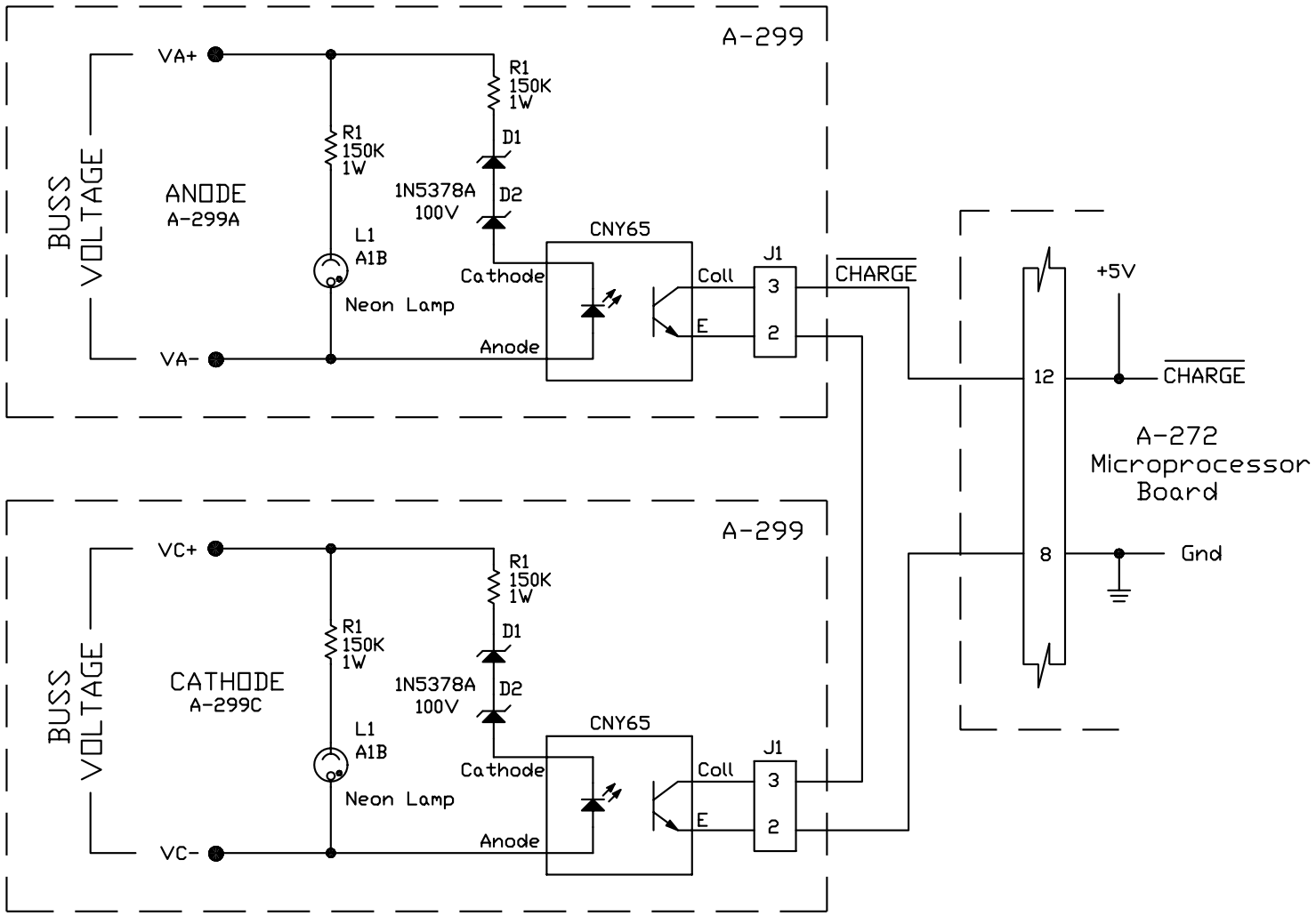


AEC INTERFACE PCB A-194

SCHEMATICS



SOURCE CHARGER PCB A-288


A-299
VA+
R1
150K
1W
R1
150K
1W
D1
BUSS
VOLTAGE
ANODE
A-299A
1N5378A
100V
D2
CNY65
L1
A1B
Cathode
Coll
J1
3
CHARGE
+5V
Neon Lamp
E
2
Anode
VA-
12
CHARGE
A-272
Microprocessor
Board
A-299
VC+
R1
150K
1W
R1
150K
1W
D1
BUSS
VOLTAGE
CATHODE
A-299C
1N5378A
100V
D2
CNY65
L1
A1B
Cathode
Coll
J1
3
Neon Lamp
E
2
Anode
VC-
8
Gnd

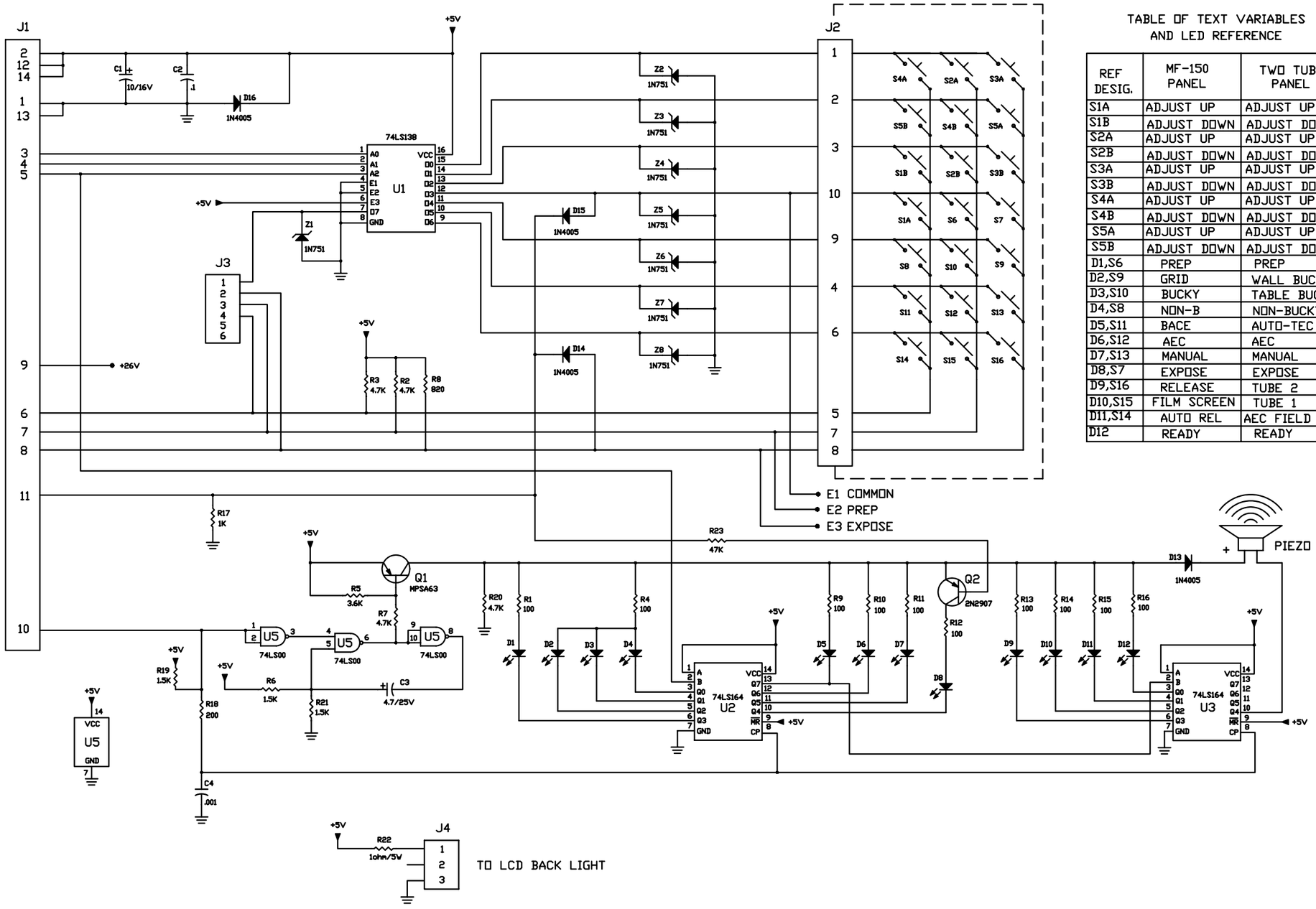
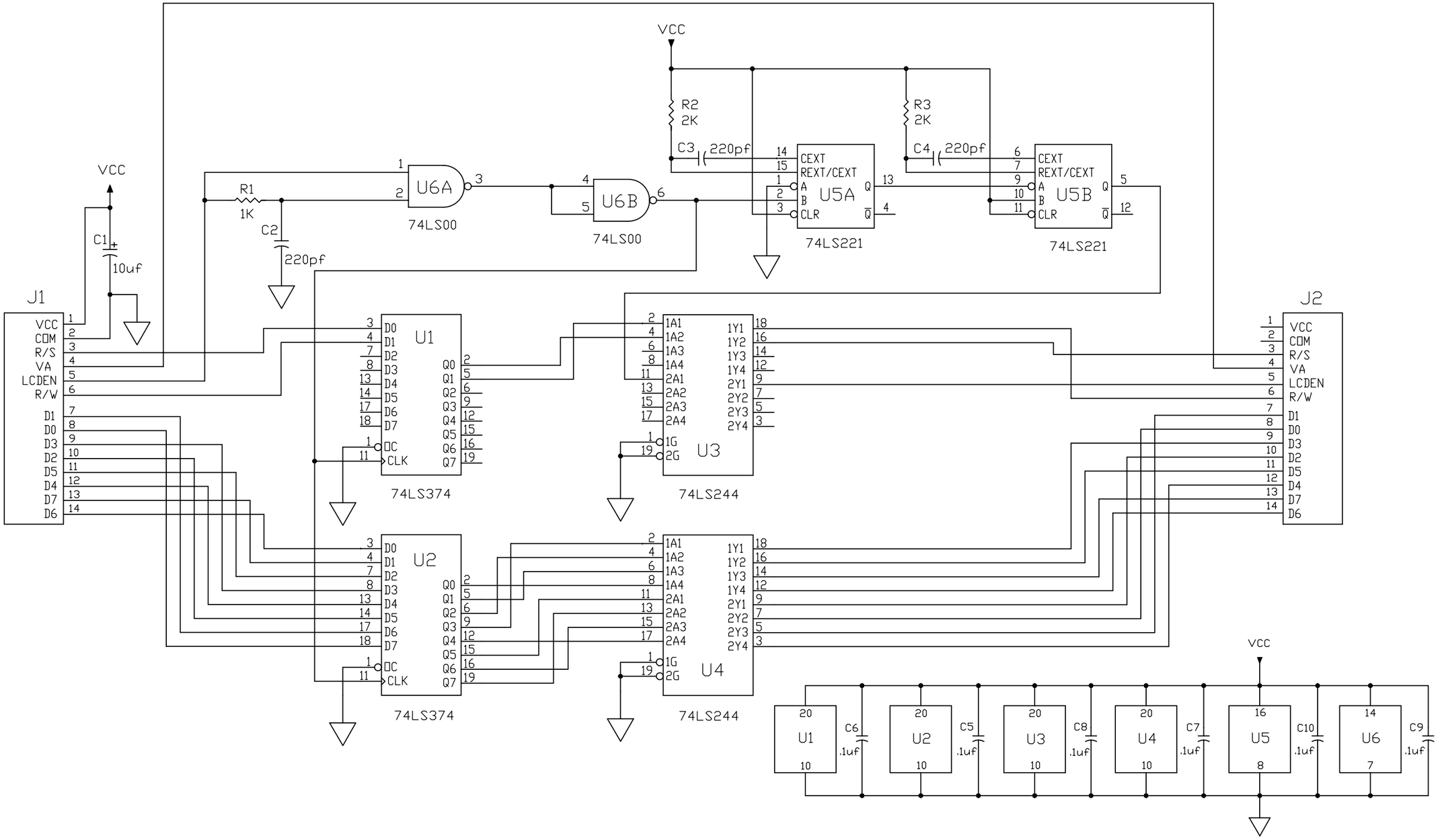


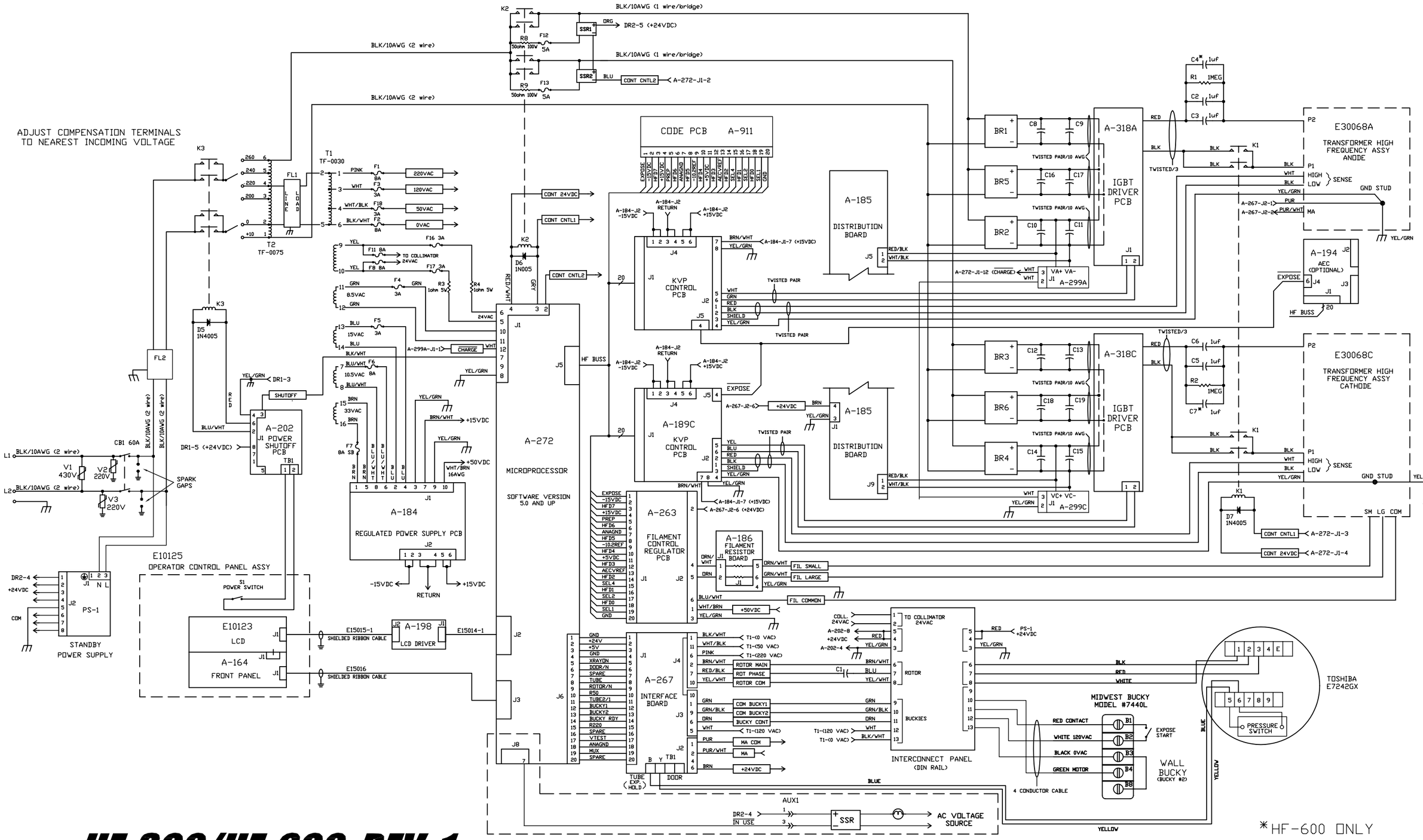
TABLE OF TEXT VARIABLES
AND LED REFERENCE

REF DESIG.	MF-150 PANEL	TWO TUBE PANEL
S1A	ADJUST UP	ADJUST UP
S1B	ADJUST DOWN	ADJUST DOWN
S2A	ADJUST UP	ADJUST UP
S2B	ADJUST DOWN	ADJUST DOWN
S3A	ADJUST UP	ADJUST UP
S3B	ADJUST DOWN	ADJUST DOWN
S4A	ADJUST UP	ADJUST UP
S4B	ADJUST DOWN	ADJUST DOWN
S5A	ADJUST UP	ADJUST UP
S5B	ADJUST DOWN	ADJUST DOWN
D1,S6	PREP	PREP
D2,S9	GRID	WALL BUCKY
D3,S10	BUCKY	TABLE BUCKY
D4,S8	NON-B	NON-BUCKY
D5,S11	BACE	AUTO-TEC
D6,S12	AEC	AEC
D7,S13	MANUAL	MANUAL
D8,S7	EXPOSE	EXPOSE
D9,S16	RELEASE	TUBE 2
D10,S15	FILM SCREEN	TUBE 1
D11,S14	AUTO REL	AEC FIELD SEL
D12	READY	READY

SCHEMATICS

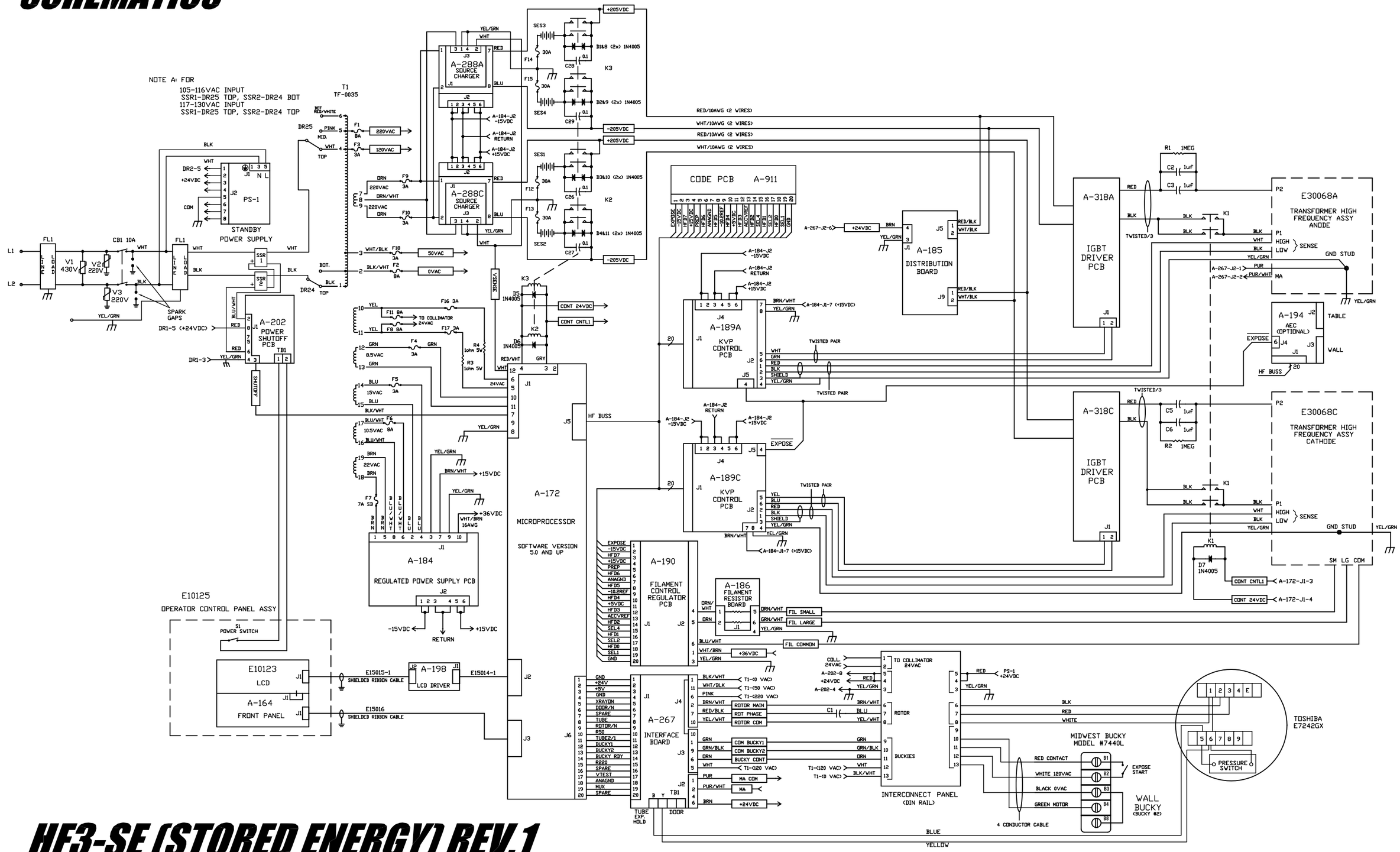


OPERATOR CONTROL PANEL DRIVER PCB A-198



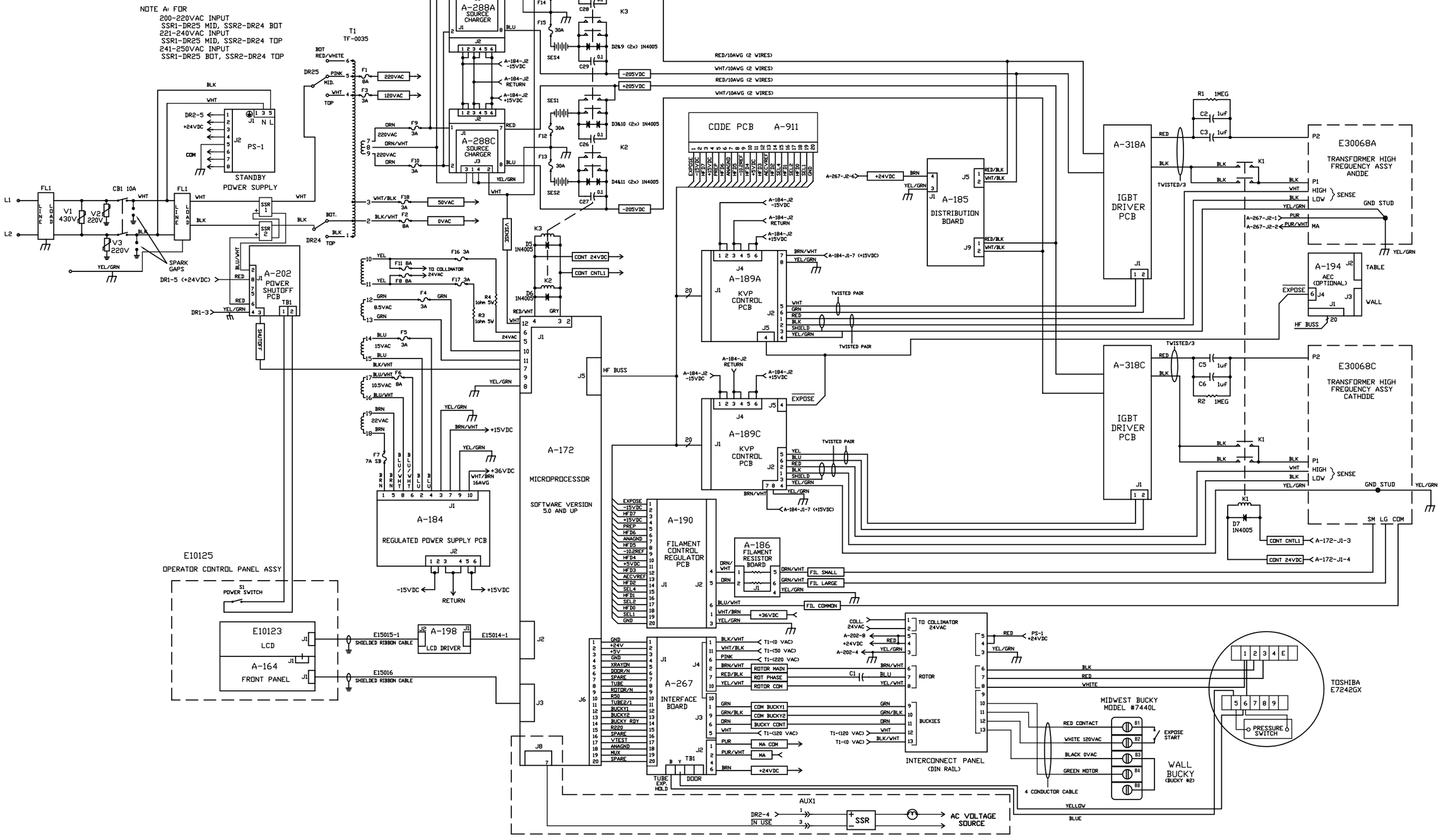
HF-300/HF-600 REV. 1

SCHEMATICS

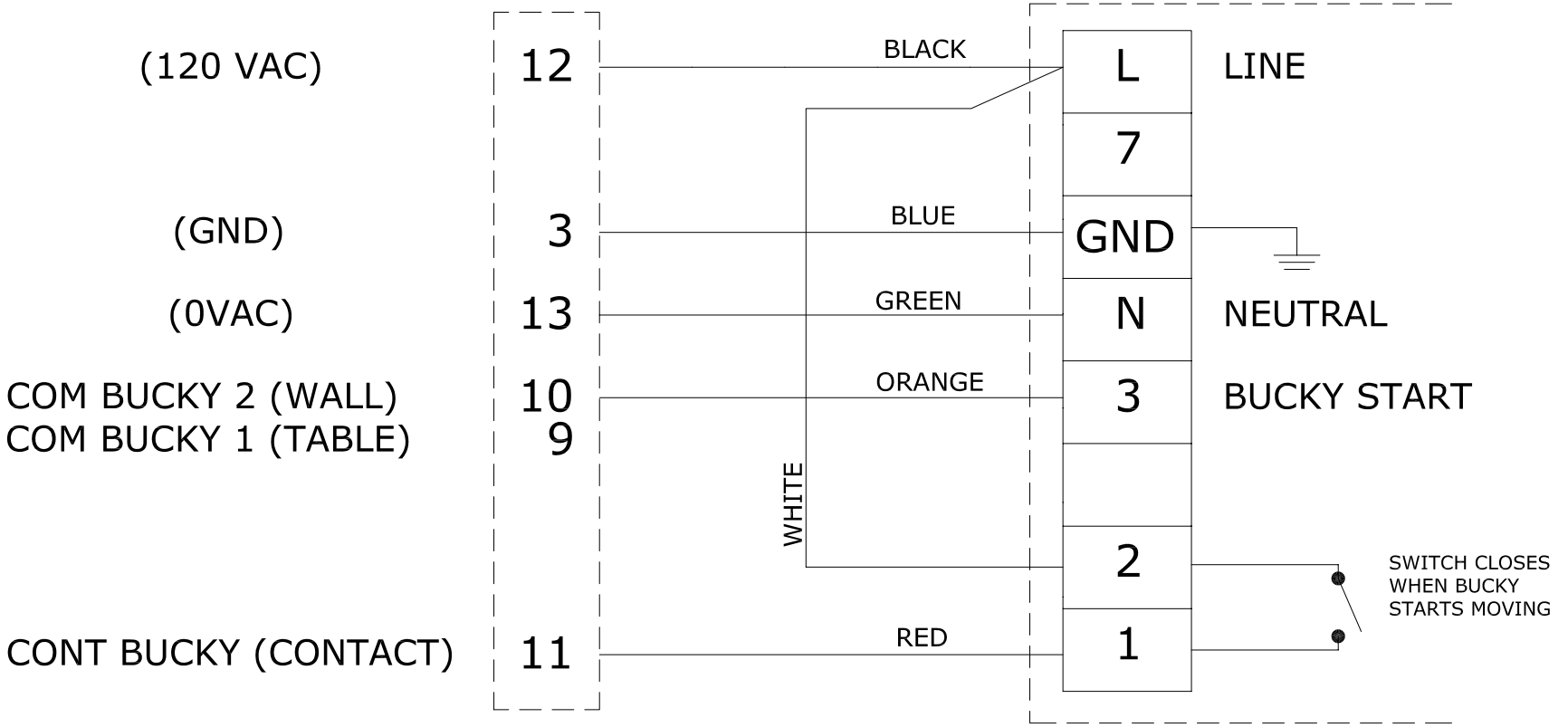


HF3-SE (STORED ENERGY) REV.1

SCHEMATICS



HF3-SEE (STORED ENERGY) REV.1



Standard Cable is 30ft. long.
Use WR-0305, 6 conductor, 20awg.

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GENERAL NOTE
UNLESS OTHERWISE SPECIFIED
THREE PLACE DECIMAL
.XXX ± .010
.XX ± .030
.X ± .050
ALL PARTS MUST BE DEBURRED AND FREE OF SHARP EDGES

Health Care Manufacturing Inc.

Schematic: Eureka
True Speed
Wall Bucky

DRAWN BY	SIZE	FSCM NO.	DWG NO.	REV
C. Morrow	B		Eureka_ts	
APPROVED	SCALE	Date	SHEET	